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Testing Machines as Related to the Foundry*

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In the constant search for positive knowledge of the qualities of materials, it is becoming more and more the practice of manufacturing plants to establish their own testing laboratories. New tests and new testing machines which have been devised to fill the needs of the expanded testing field, as they were brought up in the foundry, are recounted and explained by the author.

TESTING machines in general are today well known to the engineer and foundryman. Such machinery has developed so greatly in later years, that whereas thirty to forty years ago such machines were only occasionally used, today they are considered indispensable and a requisite for any up-to-date foundry.

Testing machines are installed in foundries for two general purposes: either to improve the product and thus promote reputation by having a name for supplying the best that is made; or to meet specifications set by the purchaser. There are some manufacturers who go a step further, enter the research or experimental field of testing and equip laboratories with special testing machines, in order not only to test material for tensile or transverse strength, but to test with regard to the particular use to which it is put and also to demonstrate its value in other fields and thereby create a new market by demonstrating its value under prescribed conditions. This class of testers is naturally the one on which the progress in any industry largely depends and from which the industry at large derives a benefit, although possibly not taking advantage of it until driven to do so by competition.

Testing in years gone by was, to a greater or lesser extent, considered a luxury and, by some, foolish and unnecessary; but today it is one of the best assets and greatest instruments of production because it promotes higher grade materials selling at higher prices. The first commercial testing machines in this country were designed about fifty years ago and the first so-called universal screw power testing machine over forty years ago, by Tinius Olsen. Today such machines are made in many sizes to test any material.

In addition to universal testing machines for tension, compression and transverse testing, several hundred other types and sizes of testing machines have

*Address, illustrated by lantern slides, delivered at a meeting of the Foundrymen's Association.

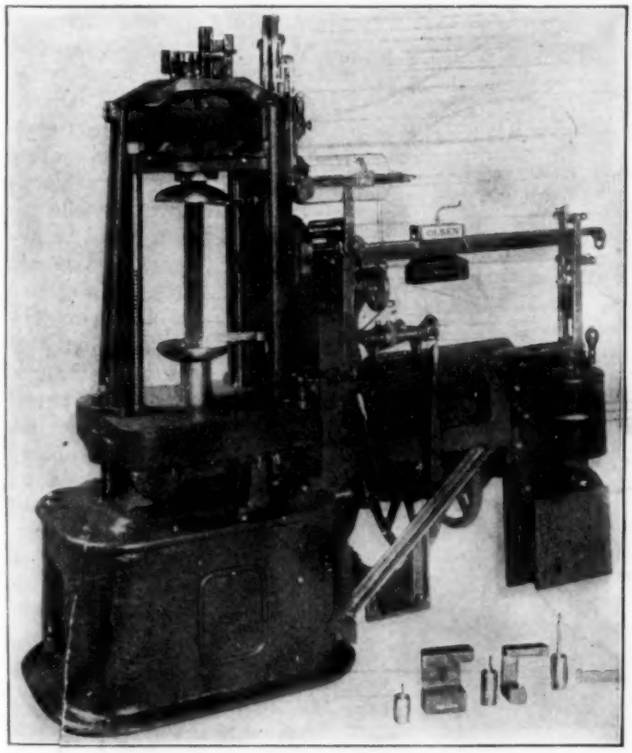


FIG 1. THREE-SCREW UNIVERSAL TESTING MACHINE WITH AUTOMATIC RECORDING DEVICE

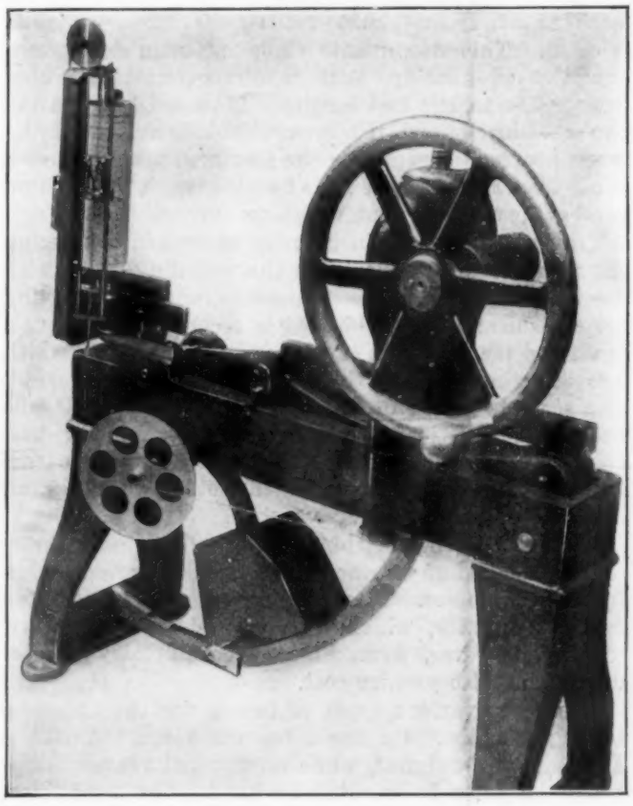


FIG. 2. AUTOGRAPHIC TRANSVERSE TESTING MACHINE

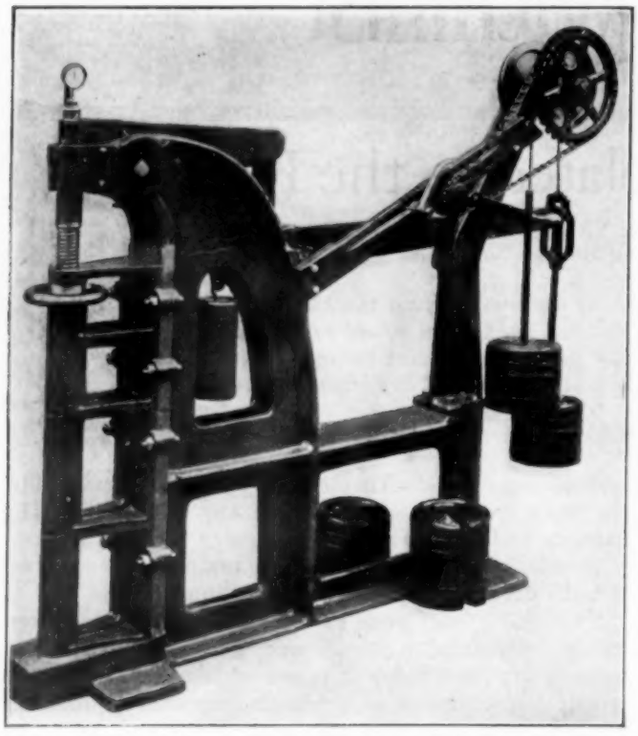


FIG. 3. STANDARD LEVER TYPE BRINELL HARDNESS TESTING MACHINE

been developed and built. Such of these as bear on the quality of foundry products are treated of in this article.

The machine used mostly by large foundries, which are required to make both tensile and transverse tests, is what is known as the universal testing machine, and depending on the size of specimen to be tested, a machine of from 30,000 to 100,000 lb. capacity is selected. This machine is designed on a four-screw principle of gearing, with a direct-connected motor drive. The tensile test specimen is placed between the two crossheads and the lower head driven down by screw gearing, thus pulling the specimen apart, the load being transmitted to the scale beam through the medium of the upper head and weighing levers.

Transverse test specimens may be broken by placing them on suitable supports on the weighing table, with specified distances between supports, and then running the crosshead down. The load is recorded on the scale beam and the deflection is read from an indicator which measures the motion of the specimen at its central point. The scale beam, in order to take care of both tensile and transverse test specimens, is, for foundry use, generally supplied with two poises, one reading to capacity for the tensile test and the other to one-tenth capacity for the transverse test.

Universal testing machines are also built on a three-screw principle of gearing which is an improved design for such machines. This type gives a greater clearance for the operator, which is a very desirable feature, causing, however, a machine of considerably greater weight and also greater cost.

There are various types of beams for the universal testing machine. On the automatic beam the load is automatically weighed, while on the dial vernier screw beam the poise is operated by hand. The very latest type of machine (shown by Fig. 1) is equipped with an automatic and autographic attachment, which records the relation between stress and strain for tension, compression or transverse test, for any point in the travel of the crosshead, up to the rupture point of the test specimen. The stress may be recorded in three or more magnitudes, as may be desired, while the strain is magnified, in this particular machine, ten times. Highly magnified diagrams may be secured for a light wire as well as for the heaviest specimen within the capacity of the machine.

The universal testing machines described cover all requirements for specimen tests. It is often desired to test full size, completed members, especially in railroad work, such as couplers, bolsters, side frames, etc., and machines of this type are built which will weigh up to 1,000,000 lb. Many steel foundries build ship anchors which must be proof-tested and this work is accomplished on an anchor tester designed for the purpose. Such machines are generally installed with capacities ranging from 200,000 to 400,000 lb., although Olsen machines have been built, arranged for anchor testing, up to 2,000,000 lb. capacity.

The transverse test for foundry products is such a valuable one, and one so greatly used, that many sizes and designs of such machines are available, depending on specifications for such tests. The standard machine for making small standard transverse tests is of the lever type. The test bars are either 1 in. square or round with an area of 1 square inch. They are placed on supports 12 in. between centers; the load is applied by handwheel and weighed on a scale beam, while a suitable device measures the deflection of the bar, correcting for the motion of the lever.

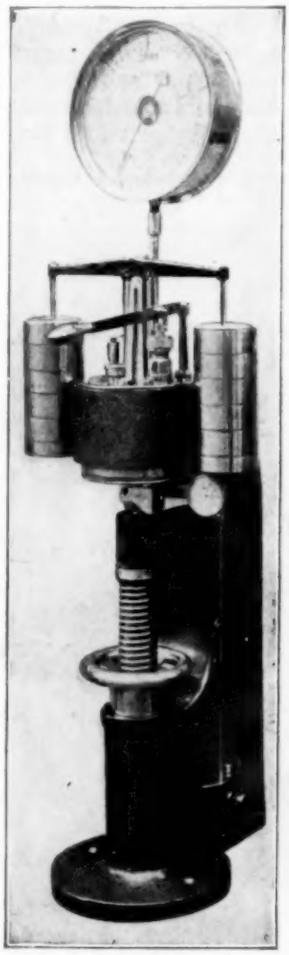


FIG. 4. HYDRAULIC TYPE BRINELL HARDNESS TESTING MACHINE

This type of machine is a good one, but in the light of modern practice a more complete test is demanded, and to cover such a demand the autographic transverse testing machine, as shown by Fig. 2, has been developed. This machine, merely by the turning of a handwheel, will scribe on the recording drum a highly magnified stress-strain diagram for a transverse test and give the operator a permanent record (which may be filed away) in less time than it takes to make an ordinary test in a lever type of machine. It is designed on a combined lever-pendulum basis of weighing. The rotation of the recording drum accurately records the load on square cross-section paper, correcting for the sine angle of the pendulum, while the motion of the pen measures the deflection of the bar.

Among the special tests to which foundry iron, steel, bronze or aluminum may be

subjected are hardness, impact, alternate stress, endurance, wear or abrasion torsion and cutting quality. For hardness the Brinell test is generally used. It consists of causing a standard Brinell ball of 10 mm. diameter to penetrate the metal under a load of 3,000 kg. for a period of 15 sec. and measuring the width of imprint with a special microscope, referring the readings so obtained to a table which will at a glance give the Brinell hardness number. The depth of imprint also can be measured by an additional attachment. This is done in routine work to procure comparative readings.

In Fig. 3 is shown a standard lever type Brinell hardness testing machine in which the load is applied very easily and quickly by a hand crank. The weights that apply the load to the lever system are counterbalanced and it is thus only necessary to raise the counter-balancing weights momentarily when a ratchet is applied, holding them in place until the time limit expires and the load is again released. This type of machine is very rugged and not liable to get out of order and is thus an ideal one for a foundry. Such machines are in use by the Pennsylvania railroad and various brake-shoe manufacturers, as all brake shoes must be subjected to such a test. Similar machines are arranged to be operated either by water or air pressure nd controlled by a foot-valve. They are largely used by automobile manufacturers and parts makers who test all their material for hardness.

The hydraulic type of Brinell hardness testing machine is of the bench type. The load is applied by hand pump and is weighed by a gage. The raising of calibrated weights insures accuracy and prevents an overload. This type of machine is the one most frequently used at present and is made in several sizes and types, including a portable type for store or stockroom use. Fig. 4 shows an Olsen hydraulic Brinell hardness testing machine with an automatic gage, which measures the depth of penetration to one one-hundredth of a millimeter.

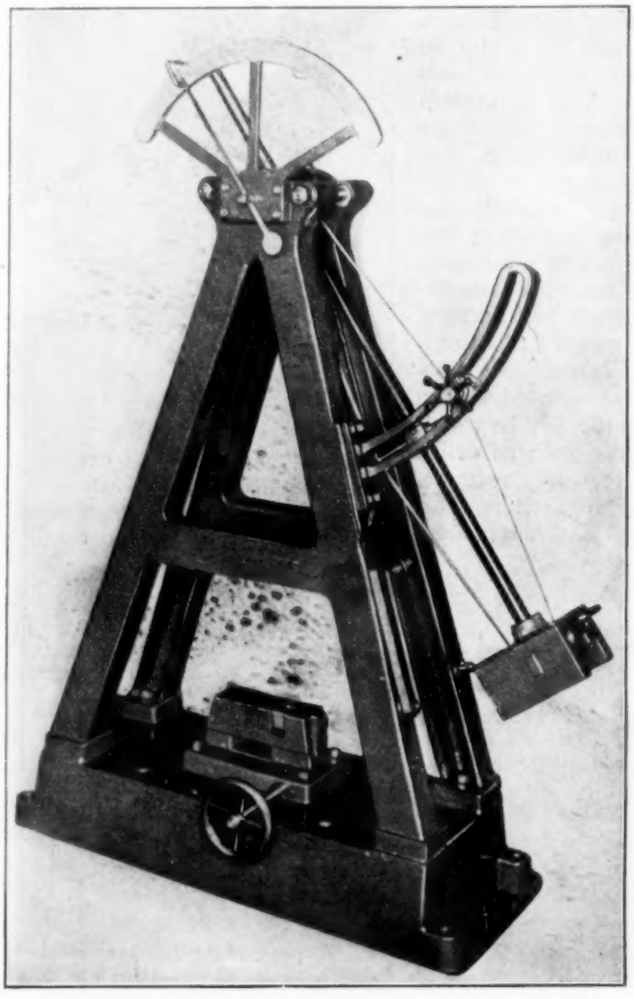


FIG. 5. IMPACT TESTING MACHINE

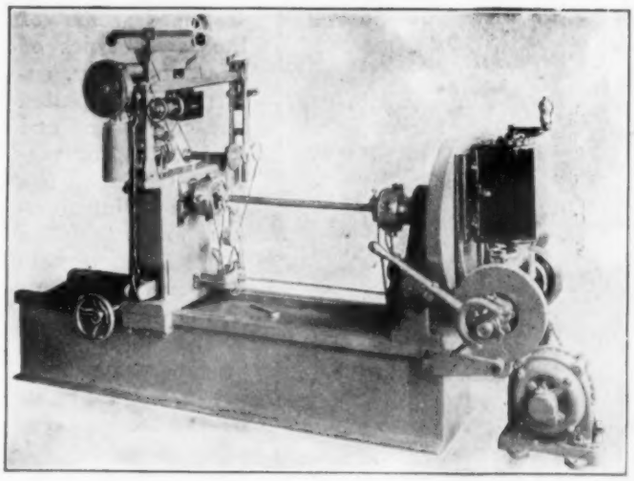


FIG. 6. AUTOMATIC AND AUTOGRAPHIC TORSION TESTING MACHINE

Impact tests are made in various ways, either on a small notched specimen, broken in the form of a cantilever, or in the form of a beam, or without notching, by shear or by impact tension. Cast iron and semi-steel are also often broken by either repeated blows from the hammer falling from a specified height, the number of drops being proportional to the strength of the test piece, or by increasing the height of fall per drop until rupture of specimen. Fig. 5 shows the most improved type of 120 ft.-lb. capacity impact testing machine, which tests a small notched specimen, either rectangular or round in section, breaking it as a cantilever. The pendulum is raised to the extreme top position and dropped. It strikes the specimen, breaking it off. The work to cause rupture is indicated by the amplitude of the continued motion of the pendulum over the scale. The specimen is held in a special clamping device operated by handwheel. This machine is adapted to testing small specimens by impact tension, indicating the work to cause rupture on the same scale.

Tension tests are now beginning to show their value in testing cast products, although more in connection with bronzes and aluminum alloys, than with steel and malleable iron. Machines for such tests are made in various sizes, not only to test samples, but full-size members, so that the strength of the design as well as of the material may be tested. Fig. 6 shows a small automatic and autographic torsion testing machine of 60,000 in.-lb. capacity which is very largely used at present. In this particular machine an autographic record may be taken in three magnitudes as to the load, and in two magnitudes as to measurement of the angular distorsion, so that highly magnified curves may be taken depending upon the characteristics of the material under test. These machines are also made with capacities ranging up to 1,500,000 in.-lb.

In the following paragraphs there are briefly

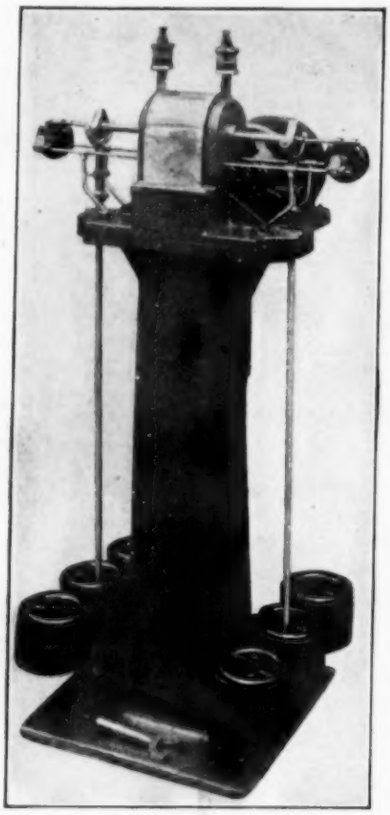


FIG. 7. WHITE-SOUTHER ENDURANCE TESTING MACHINE

described some of the latest types of alternate stress, endurance, repeated impact, wear and binding testing machines which are used in testing foundry products. The Upton-Lewis toughness and endurance testing machine No. 2, is arranged to test specimens either ¼ x 1 in. or ⅜ x 2 in. in cross-section (or other sizes by adjustment) by bending them forward and backward under a known fiber stress. The amount of this fiber stress and the number of alterations are recorded by means of a pencil shown at the top of the machine. The fiber stress is set by an adjustable eccentric and weighed through the action of two springs. This machine has been largely used for testing malleable iron and steel castings, as well as bronze and aluminum alloys and much valuable information has been secured from these tests.

The Olsen-Foster alternate torsion testing machine No. 2, takes a standard tensile test specimen of 0.505 in. in diameter and subjects it to an alternate torsion test under a known fiber stress. The fiber stress in this machine is kept constant by a mechanism operated through a handwheel. The angular distorsion consequent to keeping the fiber stress a constant, the fiber stress and the number of alternations are recorded on a continuous diagram sheet. This machine is of value in testing materials for automobile and aëroplane construction.

The White-Souther endurance testing machine, Fig. 7, has been very largely used for testing steel, copper and aluminum alloys for fatigue. The test consists primarily of rotating a specimen, loaded at the end by weights to transmit an alternate stress. The specimen may be single or double ended and is held in place by taper liners. The rotation is at the rate of 1,300 r.p.m. Revolutions are recorded by speed counters, which are automatically cut off when the specimen breaks.

The Matsumura repeated impact testing machine illustrated in Fig. 8 was developed by Prof. Tsuruzo Matsumura, of Kiota, Japan. In this machine a specimen is placed loosely on two anvils at a specified distance apart and the hammer permitted to fall repeatedly on the specimen, which is rotated through 180 deg. between blows. The number of blows is counted and is taken as a measure of resistance to shock. The force of the blow may be regulated within the limits of the machine. The specimen, when struck, resting as it does, freely on the supports, experiences an unconstrained deformation and the shock is transmitted to the supports and not to the other machine parts. This type of test is now receiving considerable thought and attention and will no doubt be a large factor in determining the quality of material in the future.

Iron and steel as well as other metals are very often used where they are subjected to considerable wear and under such conditions a wear test should be prescribed. Fig. 9 shows the Norris slip abrasion testing machine in which the specimen rotates between three rollers. The two lower rollers operate at different rates of speed, producing a slip on the specimen, and the load is applied through the upper or third roller. The specimen is accurately weighed before and after the test, and a measure of the wear thus obtained. In Fig. 10 is shown the Olsen universal efficiency testing machine, in which may be tested tools, such as drills, taps, dies, reamers, milling cutters, files, and hacksaw blades;

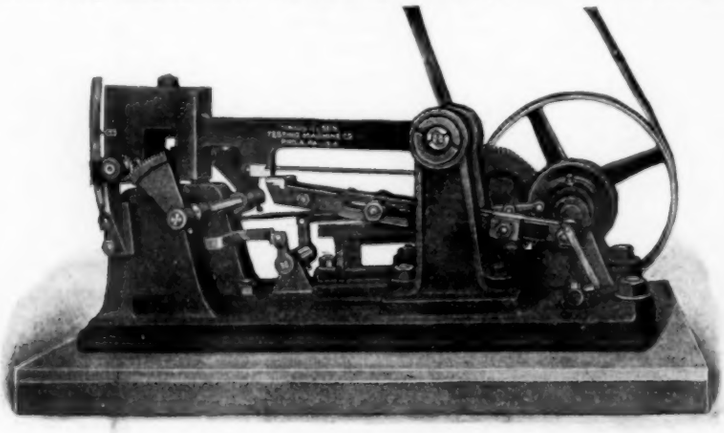


FIG. 8. MATSUMURA REPEAT-IMPACT TESTING MACHINE

FIG. 9. NORRIS SLIP-ABRASION TESTING MACHINE

cutting compounds; the cutting property of tool steel; and the properties of various metals to be cut. The machine consists of a bed, at one end of which is a weighing and recording mechanism, and at the other a driving mechanism. The weighing end of the machine is a pendulum mounted on ball bearings so that the torque may be weighed. The pendulum is fitted with change weights to give various capacities, a scale for measuring torque and a recording mechanism. A hydraulic support in the pendulum head enables the pressure at the point of tool to be registered continuously on a gage. The uses of the machine are best explained by describing some of the tests made on it. Drills are tested to show the relation between torque, penetration and pressure at the point. In this test the drill, which is rotated, is placed in the line head, as shown in the illustration, and material of known properties to be drilled, is held in the weighing head. The feed is either positive, ranging in a geometric ratio, or by gravity. The relation between the torque and penetration or number of revolutions may be recorded on the diagram drum and the pressure at the point of the drill may be read from the gage.

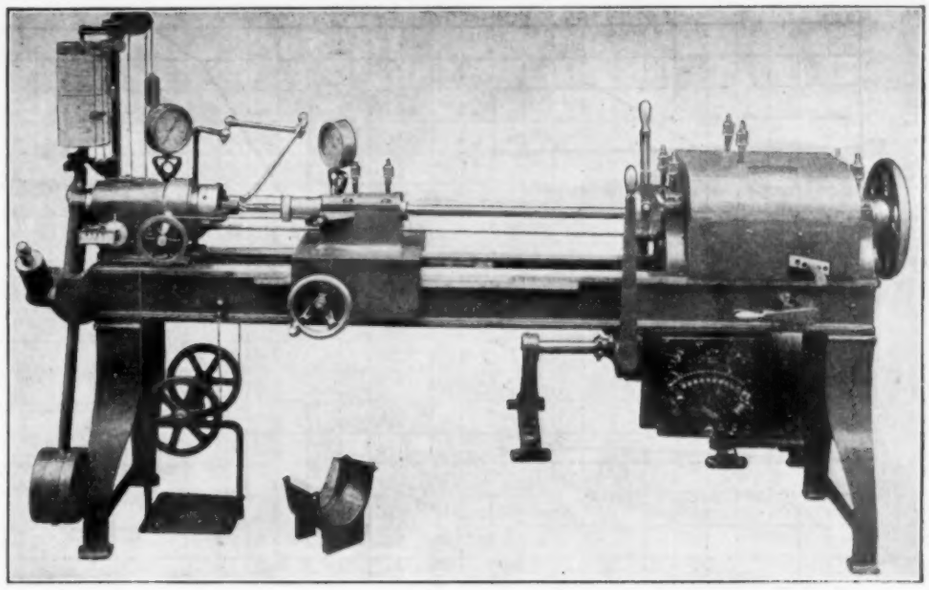


FIG. 10. UNIVERSAL EFFICIENCY TESTING MACHINE

Fig. 11 shows a hacksaw blade in the necessary attachment. The object of the test is to determine the relation between the number of revolutions and the depth of cut under prescribed conditions. Fig. 12 shows a milling cutter under test, using a single tooth and measuring the wear of this tooth by a special indicating instrument.

In similar manner files are tested to determine the relation between the revolutions and the material filed. Tool steel or metal to be machined is tested, the conditions of the one being the reverse of the other,. Fig. 13 shows a number of test curves. *A* is the result of the test of a file, *B* and *C* of ¾-in. drills, *D* of a hacksaw blade, *E* of a machine die, *F* of a trap, and *G* of a small drill.

Curve *B* is that of a ¾-in. high-speed drill running at 360 r.p.m., with a point pressure of 1,100 lb., while curve *C* is that of a ¾-in. carbon drill running at 90 r.p.m. with a point pressure of 1,350 lb. The feed and the class of material being drilled were the same in both. It is readily seen that the high-speed drill, cutting four times as fast, shows less torque as well as less pressure at the point of the drill.

Curve *G* is that of a small drill which readily shows that the torque required to penetrate is over twice that required to cut the material. It is often this excess torque required to penetrate that breaks the drill and the test shows that great care should be taken in the proper sharpening of such small drills.

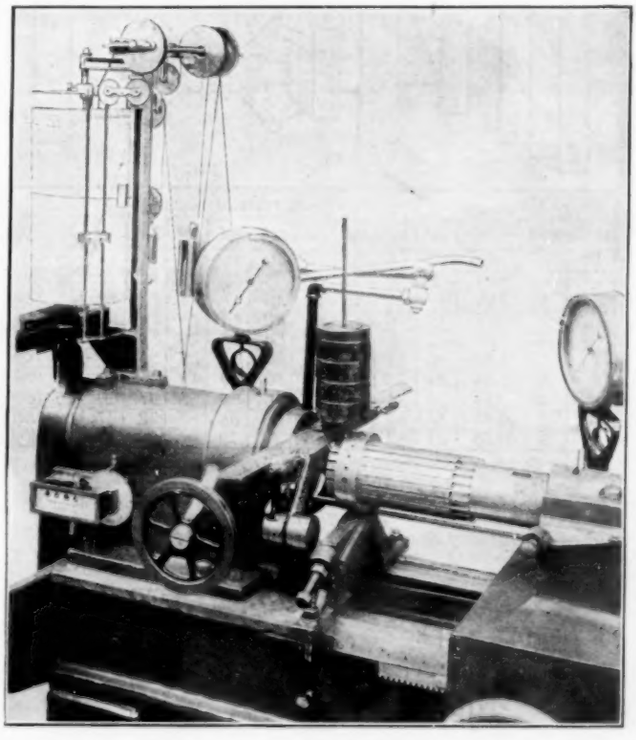


FIG. 11. HACKSAW BLADE TESTING ATTACHMENT

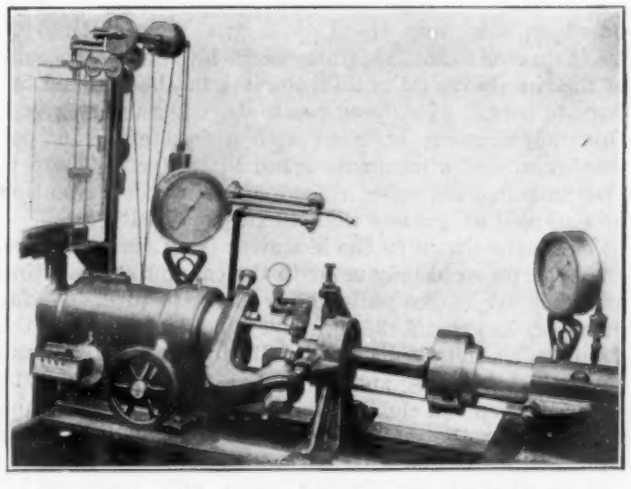


FIG. 12. MILLING CUTTER-TESTING ATTACHMENT

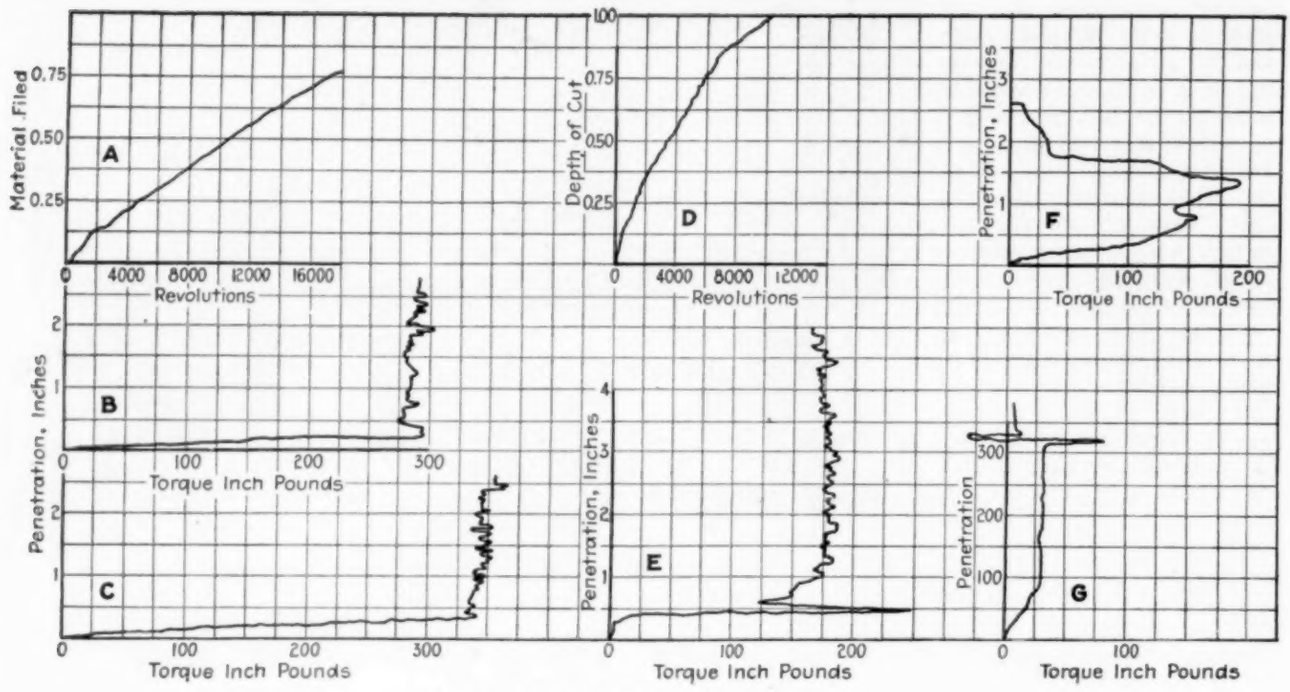


FIG. 13. DIAGRAMS OF EFFICIENCY TESTS

Curve *F* is that of tapping the hole drilled by curve *G* and the area of this diagram represents the work of tapping.

The very large range of testing machines applicable to the foundry is indicated by the action of one of the largest foundries in this country which is even now equipping a central testing laboratory which will be equipped with practically all of the various types herein described, including the universal efficiency testing machine.

Speed Table for Lathe Men

BY I. B. RICH

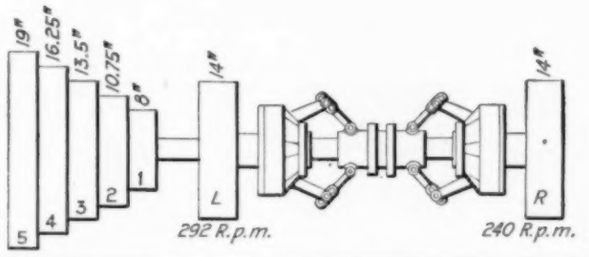
The Meese & Goddfried Co., San Francisco, Cal. is securing increased production from its lathes by the use of speed and feed tables which are framed and hung in convenient places for all lathe operators to see. The one illustrated herewith is for a 36-in. Niles pulley lathe.

The standard time for turning cast-iron pulleys is based on a cutting speed, with two tools cutting, of 25 ft. per minute. This may seem low but on account of the rims being quite thin, the iron has been found too hard to permit of a speed much above the figure given. One roughing cut is taken with a feed of $\frac{1}{16}$ in. per revolution and a minimum speed of 25 feet. There is one finishing cut with a feed of $\frac{1}{4}$ in. per revolution and a speed of not less than 40 ft. per minute.

The table shown in the blueprint is so arranged that the operator need only refer to the column representing the diameter of the pulley he is about to turn. If, for example, he has a 28-in. pulley he looks under the 28-in. column in the list headed "Diameter of Pulley" and finds that a cutting speed of 23 ft. per minute will be secured when the clutch lever is thrown to the left and the belt is on the second step of the cone. The operator starts with this combination (which gives him the nearest to the 25 ft. desired) and will increase his speed as much as the hardness of the casting will allow.

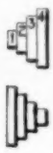
In the lower portion of the chart is a similar table to be used as a guide in obtaining the desired feed. This shows that thirteen per inch is the nearest to the $\frac{1}{16}$-in. feed wanted, the other feeds and the way in which they are secured being plainly shown.

These were designed by Horace P. Philips, superintendent of the Meese & Gottfried shops.



POSITION OF COUNTERSHAFT CLUTCH	CONE	SPINDLE R.p.m.	DIAMETERS OF PULLEYS 16"	18"	20"	22"	24"	26"	28"	30"	32"	34"	36"
R	1	1.63	7	8	9	9	10	11	12	13	14	15	15
L	1	2.03	8	9	10	12	13	14	15	16	17	18	19
R	2	2.55	11	12	13	15	16	17	19	20	22	23	24
L	2	3.19	13	15	17	18	20	22	23	25	27	28	30
R	3	3.88	16	18	20	22	24	26	29	31	33	35	37
L	3	4.84	20	23	25	28	30	33	35	38	41	43	46
R	4	5.85	24	28	31	33	36	40	43	46	49	52	55
L	4	7.31	30	34	38	42	45	50	53	57	60	65	69
R	5	9.19	38	44	48	53	58	63	67	72	77	82	86
L	5	11.48	47	54	60	66	72	79	84	90	97	102	108

Cutting Speeds are shown in Feet per Minute.
Roughing Cut
Minimum Speed, 25 Ft. per Min. Feed $\frac{1}{16}$".
Finishing Cut
Minimum Speed, 40 Ft. per Min. Feed $\frac{1}{4}$".



FEED TABLE

CONE	B.G.	FEED PER IN.
1	IN	62
1	OUT	21
2	IN	53
2	OUT	12
3	IN	22
3	OUT	7
4	IN	13
4	OUT	4

SPEED TABLE FOR PULLEY LATHES

Laying the Cards on the Table

By FRED H. COLVIN
Editor, *American Machinist*

It is generally conceded that co-operation can only be secured when mutual confidence prevails. And confidence, according to some of our best thinkers on industrial matters, is best secured by what is generally termed "laying the cards on the table." A very complete example of this method—one where facts and figures are laid open for the inspection of all—is shown herewith.

AFTER five years of practical experience with a plan that is based primarily on "laying all the cards on the table," and that uses the shop committee system as a means of contact between the management and the workers, the White Motor Co., of Cleveland, Ohio, is now ready to state its belief in the advantages of such methods as a step in the solution of the problems which are today confronting industrial managers everywhere.

The main features of this method have been brought out in previous articles, but it is well not to forget a few of the salient points in considering all questions of the kind. Wages have increased 110 per cent since 1914, output per man has nearly doubled, there is no piece work, nothing but straight day wages, and no arbitrary efficiency standards or practices are used—and the price of trucks has advanced only 10 per cent.

The following figures as to production, wages, costs, etc., show how thoroughly the old policy of secrecy has been abandoned and the freedom with which the facts of the business are discussed with the men. Nor are they hidden from others, as can be seen. The tables shown, as well as the "maxims," are taken from large blueprints which are posted in conspicuous places where all who run may read. To those who fear to let too much be known, the answer of those who believe in publicity is that imagination usually pictures profits at a much higher figure than they really are. When someone tells the men that enormous dividends are being paid, and the actual figures are not shown, the men naturally assume all statements as true—that "silence gives consent."

The figures in Table I show interesting facts as to the plant and production value, which is something of an education to most men in the shop, and show that with a plant investment only twice as large as in 1914, the output is nearly four times as great. And this with a price advance of only 10 per cent. The ratio between direct and indirect labor remains approximately the same, while the total labor cost has increased from 18.71 per cent to 24.99 per cent of the product.

Table II is a real lesson in shop finance as it shows just what is meant by factory value of trucks produced, the output per man, the increase

Maxims

Capital is only production minus consumption. Business originally was founded on service. The customer pays all. The public suffers all. Absentee ownership may or may not be a curse. Absentee management is always a curse.

Declaration of Principles

No Entangling Alliances.
Free Speech, and Free Press.
Recognition of Individual Rights.
No Discrimination Against Nationality, Political Belief or Creed.
No Discrimination Against Any Organization.
Base Wage, Based on Buying Power.
Craftsmen's Wages Adjusted to the Above.
Production of a Necessity.

Speaking for the White Motor Co. alone, our policy has been in the past and is now to limit payment of dividends to 8 per cent on capital stock. Through opinion, in the factory, in the community, and in the home, the soundness of the above will be checked. THE WHITE MOTOR CO.

Year	Factory Value of Product	Average No. Men	Estimated Buying Power of $1	Average Weekly Earnings Based on 51 Wks Work	Hours Work	Hours Pay	Total Wages	Trucks Per Man Per Year	Factory Value of Trucks Produced Per Man * Per Year
1910	$ 3,836,290	1,072		$14.04	60	60	$ 767,496	2.290	$3,578.63
1911	$ 5,097,523	1,419		$12.82	59	60¼	$ 927,696	1.985	$3,592.33
1912	$ 6,739,756	1,852		$13.53		61½	$1,278,426	1.785	$3,639.17
1913	$ 6,795,196	1,964		$13.45			$1,347,064	1.785	$3,459.87
1914	$ 9,023,172	2,202	$1.00	$15.03			$1,688,467	1.924	$4,097.72
1915	$21,040,078	3,758	90c.	$16.51	54½	59½	$3,163,857	2.460	$5,598.72
1916	$17,053,311	3,611	86c.	$17.34			$3,186,921	2.082	$4,722.60
1917	$22,448,927	4,341	72c.	$20.94			$4,637,105	2.040	$5,171.33
1918	$30,952,748	4,844	55c.	$27.07			$6,688,051	2.720	$6,389.91
1919	$35,356,000	5,475	50c.	$31.64	49½	52	$8,835,000	2.751	$6,456.62

*THE FACTORY VALUE OF OUR TRUCKS PRODUCED INCLUDES:

MERCHANDISE & SUPPLIES, ETC.
LABOR
POWER & FUEL
MAINTENANCE & REPAIRS
FACTORY SALARIES & GENERAL ADMINISTRATIVE EXPENSE
INSURANCE
FEDERAL, STATE & CITY TAXES
PLANT EXTENSION, ETC.
DIVIDENDS

Note — Trucks Per Man 2.751; Value $6,456.62; Average Value $2,347.00

THE RESULTS SHOWN BY THE TABLES ARE DUE TO THREE REASONS:

One-Third Due to Ample Capital & Plant & Methods of Manufacture
" " " Management
" " " the Men Voluntarily Giving an Honest Day's Work.

Note — Average Truck Price Increased Approximately 10 Per Cent Since 1914

TABLE I. OUTPUT AND LABOR COSTS SINCE 1914

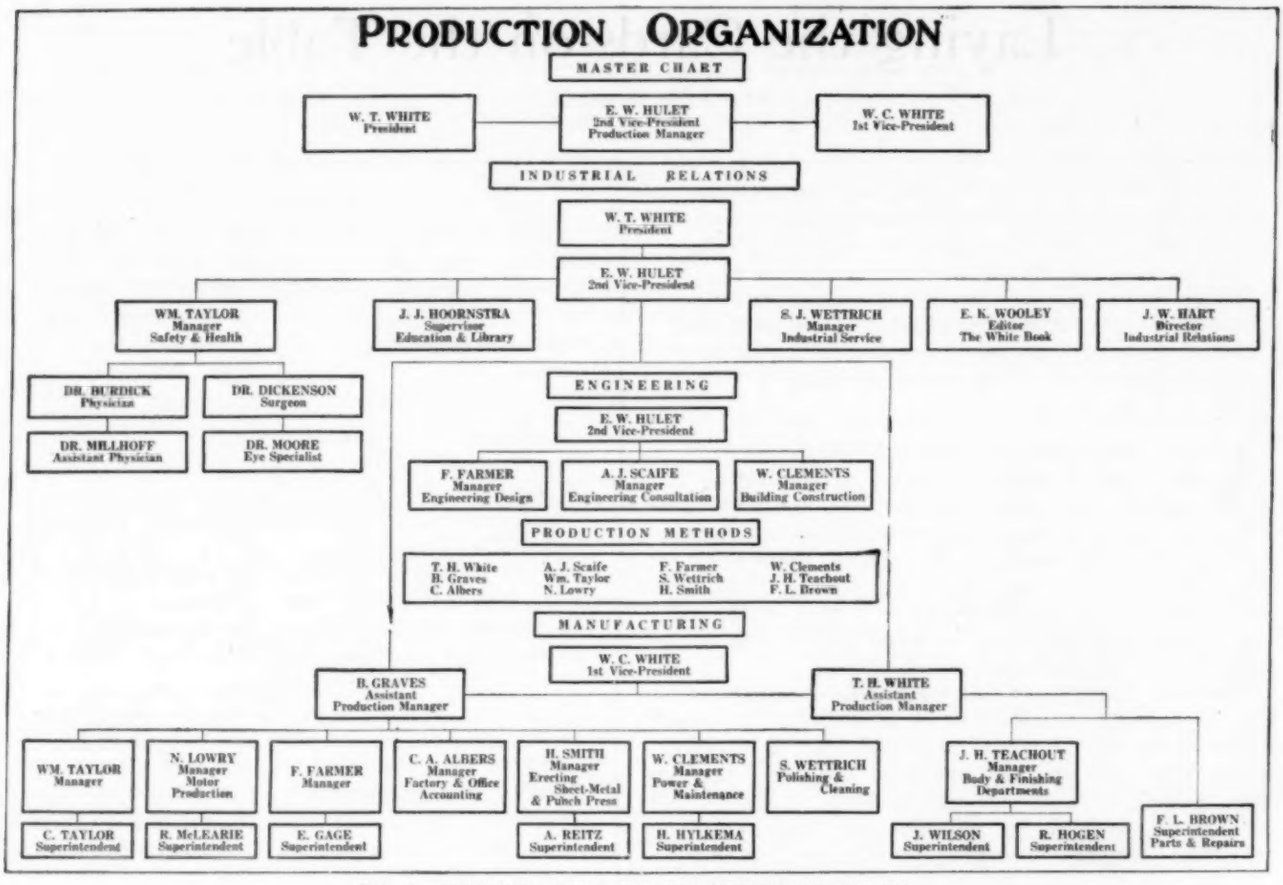

PRODUCTION ORGANIZATION
MASTER CHART
W. T. WHITE President
E. W. HULET 2nd Vice-President Production Manager
W. C. WHITE 1st Vice-President
INDUSTRIAL RELATIONS
W. T. WHITE President
E. W. HULET 2nd Vice-President
WM. TAYLOR Manager Safety & Health
J. J. HOORNSTRA Supervisor Education & Library
S. J. WETTRICH Manager Industrial Service
E. K. WOOLEY Editor The White Book
J. W. HART Director Industrial Relations
DR. BURDICK Physician
DR. DICKENSON Surgeon
DR. MILLHOFF Assistant Physician
DR. MOORE Eye Specialist
ENGINEERING
E. W. HULET 2nd Vice-President
F. FARMER Manager Engineering Design
A. J. SCAIFE Manager Engineering Consultation
W. CLEMENTS Manager Building Construction
PRODUCTION METHODS
T. H. White B. Graves C. Albers
A. J. Scaife Wm. Taylor N. Lowry
F. Farmer S. Wettrich H. Smith
W. Clements J. H. Teachout F. L. Brown
MANUFACTURING
W. C. WHITE 1st Vice-President
B. GRAVES Assistant Production Manager
T. H. WHITE Assistant Production Manager
WM. TAYLOR Manager
N. LOWRY Manager Motor Production
F. FARMER Manager
C. A. ALBERS Manager Factory & Office Accounting
H. SMITH Manager Erecting Sheet-Metal & Punch Press
W. CLEMENTS Manager Power & Maintenance
S. WETTRICH Polishing & Cleaning
J. H. TEACHOUT Manager Body & Finishing Departments
C. TAYLOR Superintendent
R. McLEARIE Superintendent
E. GAGE Superintendent
A. REITZ Superintendent
H. HYLKEMA Superintendent
J. WILSON Superintendent
R. HOGEN Superintendent
F. L. BROWN Superintendent Parts & Repairs

FIG. 1. ORGANIZATION OF THE WHITE MOTOR CO.

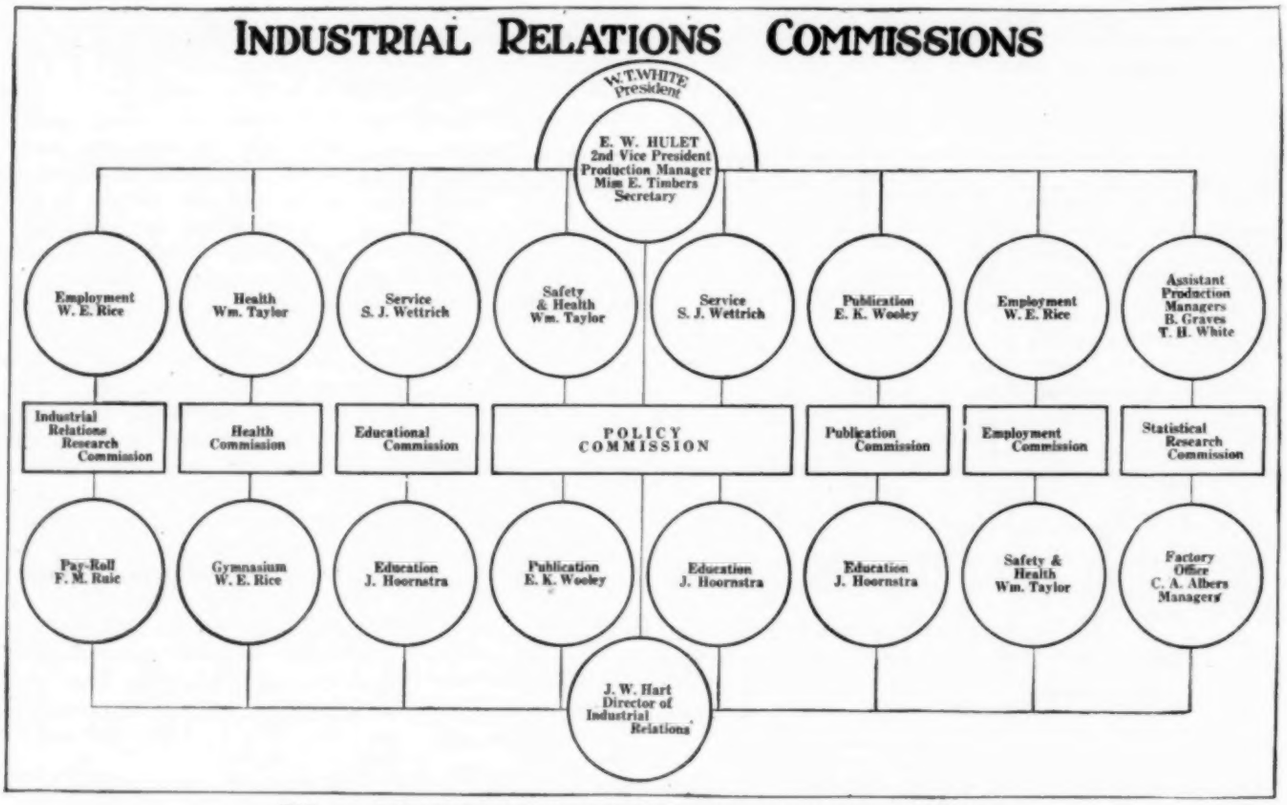

INDUSTRIAL RELATIONS COMMISSIONS
W. T. WHITE President
E. W. HULET 2nd Vice President Production Manager Miss E. Timbers Secretary
Employment W. E. Rice
Health Wm. Taylor
Service S. J. Wettrich
Safety & Health Wm. Taylor
Service S. J. Wettrich
Publication E. K. Wooley
Employment W. E. Rice
Assistant Production Managers B. Graves T. H. White
Industrial Relations Research Commission
Health Commission
Educational Commission
POLICY COMMISSION
Publication Commission
Employment Commission
Statistical Research Commission
Pay-Roll F. M. Ruic
Gymnasium W. E. Rice
Education J. Hoornstra
Publication E. K. Wooley
Education J. Hoornstra
Education J. Hoornstra
Safety & Health Wm. Taylor
Factory Office C. A. Albers Managers
J. W. Hart Director of Industrial Relations

FIG. 2. ORGANIZATION OF INDUSTRIAL RELATIONS COMMISSION

in men, wages and, best of all, output, since 1910. It also shows the decrease in number of working hours as well as a much greater decrease in the purchasing power of the dollar. The success is credited to three sources: capital, management and an honest day's work, in equal measure.

THE WHITE MOTOR COMPANY				
COMPARATIVE FIGURES		12 MONTHS 1914	12 MONTHS 1918	12 MONTHS 1919 (December Estimated)
PRODUCTION VALUE		$9,023,172	$30,952,748	$35,356,000
PLANT VALUE		$1,879,000	$ 3,200,000	$ 3,650,000
RATIO, PRODUCT-PLANT		4.8 to 1	9.7 to 1	9.6 to 1
TOTAL PRODUCT (Parts Included)		4,255	13,163	15,064
AVERAGE NUMBER OF MEN		2,202	4,844	5,475
AVERAGE WEEKLY EARNINGS (51 Weeks)		$15.03	$27.07	$31.64
TOTAL WAGES, Factory Employees		$1,688,467	$6,688,051	$8,835,000
RATIO, WAGES-PRODUCT	Direct	13.81%	15.84%	18.35%
	Indirect	4.90%	5.81%	6.63%
	Total	18.71%	21.65%	24.99%

TABLE II. DETAILS OF COSTS AND DISTRIBUTION OF CREDITS

The organization of the White Motor Co. is shown in Fig. 1. Perhaps the most striking feature is that the production manager is a vice president and has a voice in the management and policy of the company. There is a growing belief that, unless this is done, unless the engineering or technical end of the business has its voice in the entire management best results cannot be secured. Financial men are necessary but it is believed that they should not dominate all the policies of management. Nor do the financial men have a monopoly of the ability to pick good men, even though some of them seem to feel that this is the case. We need only to look back at the many fiascos in plant management, where bankers picked the executives in the munition factories to bear this out. It must be remembered that the White Motor Co. has a system of representative committees, one man being chosen to represent every ten men in the shop. Figs. 1 and 2, however, show how little machinery there is about the whole thing and how the production manager ties up closely and directly with all the different activities. In Table II, it will be seen how the policy commission ties together the production, safety and health, service, publication, education and industrial relations. Education also plays a big part in the plan of industrial work of the company, as can be seen. The plans are so simple, the actions so direct, that they get as near to the old personal contact as seems possible in a large shop. The plan works remarkably well and can be studied carefully to advantage. But as with all successful plans, it must be remembered that success depends more on mutual confidence, on the spirit behind it, than on the plan itself.

Reminiscences of an Old School Machinist

By R. THOMAS HUNTINGTON

THE modern bench lathe with all its attachments, including milling and grinding devices as well as provision for accurate thread cutting, is almost a machine shop in itself. How different was the lathe of my boyhood when I entered the shop as an apprentice 57 years ago I will leave to the reader to judge. The bed of the lathe upon which I worked in those early days consisted of two stringers of wood (hard pine, I think it was) 4 by 8 inches in size, separated by three pieces of wood ¾ in. thick, 3½ in. wide, and about 4 in. long; one of these pieces being at each end of the clear space of the bed—about 3 ft. apart, and the third piece at the outer end of the headstock. These five pieces of wood were raised from the bench on blocks 3 or 4 in. thick placed practically under the separating blocks. The bed of the lathe was firmly bolted to the bench by six bolts with heads let in a little below the surface so as not to interfere with the movement of the tailstock or "tee" rest. There was no countershaft; the driving cone was on the main line, or a jackshaft according to the location of the lathe, and the workman started and stopped the lathe by throwing on or off the belt by hand. The head- and tailstocks were held firmly in position by a wedge passing through a wrought iron stirrup or strap cast into the metal of the stocks. The headstock remained stationary and was held in line by a key, or feather, about ¾ in. wide fitting into the space between the two stringers of wood that formed the bed. If there were a number of lathes in line, the stringers were made long enough to accommodate all the headstocks with room enough between them to allow ample movement to their respective tailstocks. There was no real standard then in existence; each shop having its own designer, and the designs were many and varied. The tailstocks were similar ir principle to those with which the present-day workman is familiar, but they were held in position by the wedge before mentioned. There was not as much movement

During the last half-century the growth and development of the machine shop in the way of improved machinery, advanced ideas and methods, hitherto unheard-of materials both for working with and to be worked—though swift and at times bewildering — has been so consistent and so engrossing that the full scope of its progress is apparent to us who are within its influence only when we step aside from ourselves and, through the rearward mental vision of our older associates, recall conditions of the earlier days when machines of precision were but dreams and many of the jobs today considered elementary called for the highest degree of skill. To those of us whose hair has grown gray in the service, the reminiscences of our fellow tradesman, himself 73 years old, bring back as in a dream the pleasures and the triumphs of the golden days of our own apprenticeships.

to the tailspindle as is now the practice as there were no deep holes to drill.

The T-rest was held to the bed by a wedge passing through a stirrup bolt which had at its upper end a square head fitting a corresponding slot in the base of the rest. There was adjustment up and down of the rest the same as now, but the rest was broader on the top to accommodate the hook-tools then in use; of which more will be said later. Some of the lathes had two T's; one for the hook-tool and one for hand tooling, chasing threads, etc.

The live center had usually a square taper shank; the hole in the spindle being shaped during the forging operation by driving in a swage of the desired shape. The shank of the tail center was round with very slight taper. The cone pulley was generally made of wood and was keyed to the spindle.

Only Hand Tools Were Used

All work was accomplished on these old lathes by means of hand tools. There were no slide rests. All drills were made of flat steel forged nearly to size and finished with a file as required. The blacksmith or tooldresser of the old days was an artist. He took particular pride and exercised a deal of patience in making good clean forgings that required but little fitting.

There were no dogs as we have them now. In drilling a hole in a piece attached to the faceplate of the lathe there would be a T- or L-shaped piece of stock, with a slot in it of somewhere about the right size for the drill to pass through, to hold the drill from turning; the drill being held back against the tail-center by hand or with a monkey wrench.

In preparing to turn round work, such as studs, bolts, etc., we did not drill center holes then as we do now Each man had three center punches: a round one of about 60 deg. included angle and a round, and a square one of about 90 deg. included angle. The sharper one would be used as a starter, followed on one end of the work by the blunt round one and on the other end by the square one.

There would be two live centers for the lathe: one round pointed one and one with a square point; both about 90 deg. included angle. The square pointed one used in conjunction with the square center-punch mark was depended upon to drive small round work, while a bent strap bolted to the faceplate and having a hole of suitable size and shape in it was used to drive square or hexagon stock.

Work was rough turned with a "hook-tool" ground on top something like a diamond point but having at the bottom a sharp point or heel to keep it from slipping on the rest. The tool was made of rectangular section stock, usually ⅜ by ½ in. and about a foot long, being held in a wooden holder about two feet long. The steel shank of the tool was fitted to a groove in the top of the wooden holder, and held by an eye bolt the eye of which was fitted to the tool shank. The threaded portion of the eyebolt, passing through a hole in the wooden holder, entered a square nut set in a handle, like a large file handle, that projected downward at a right angle from the holder. Thus the steel part of the tool could be moved in and out with relation to the wooden holder and tightened in any desired position by turning the handle.

To use the hook-tool the workman grasped the downwardly projecting handle with his left hand, rested the outer end of the holder on his right shoulder and held it down firmly with his right hand, while the pointed spur above referred to rested on the T rest immediately before the revolving work. By a peculiar twisting motion, impossible of description but imparted by both hands and a movement of the body at the same time, the tool could be made to advance along the work, taking off the stock as neatly if not as rapidly as a tool held in a modern slide-rest. The amount of work that could be accomplished in a day by this crude tool would surprise some of the present day mechanics.

In using the hook-tool a workman not only knew his business but attended strictly to it all the time; if his judgment erred or his attention wandered he would get a sudden crack behind the ear that would bring him to his senses—if it didn't deprive him of them altogether.

I remember seeing one young man, who thought he could turn a brass gong with a diamond point instead of a flat tool, laid out unconscious for half an hour. He was warned against using the diamond point, but like many another young man was self-sufficient in his own ignorance and scorned to accept the instructions of his elders. Experience is a dear teacher but leaves no doubt as to point of its teaching.

Finishing was usually done with a square graver. For starting a thread we used a diamond shaped graver and we obtained the proper pitch by a slight twist of the wrist which took some time to acquire.

After a thread was started a chaser was used to finish it. The chaser was a flat tool with six or more teeth of the shape, size, and pitch of the thread it was intended to cut. The chasers were usually made by cutting in the teeth with a hob of the same pitch as the tap that was to be used to thread the corresponding nut, but some expert workmen could file these chasers; using the tap as a templet and gage.

The apprentice of those days was given a lathe to work on only after having been in the shop for six months. I am working today, in my seventy-third year, on a modern bench lathe with all its up-to-date accessories, and as I cast back in my mind to my own apprenticeship in those far off days I wonder what some of the fellows who have learned their trade in recent years would do if they were to be put up against the conditions of fifty seven years ago.

Twist Drills and Drill Rod Unknown

Twist drills were unknown; there was no bright drawn stock, the diameter and roundness of which could be trusted to an infinitesimal fraction of an inch; the only grinding wheels in existence were made of wood and covered with leather to which emery was attached by covering the leather with glue and rolling the wheel in a trough of loose emery.

Most of the larger lathes had a chain feed, the chain passing over a sprocket wheel under the headstock and operated by a large wooden-rimmed handwheel. There were a few geared lathes for cutting threads on large work.

In 1868 I worked on my first screw-cutting lathe in the shop of William Sellers & Co. of Philadelphia, which shop was equipped with the most improved machinery then in use. Here, also, I first made the acquaintance of snap and thread limit gages. Here for the first time I found a full set of dogs for turning work of all sizes, and the old square center with which I had become so

familiar, became but a memory. All lathe centers were ground to an angle of 60 degrees.

There was a machine in the Sellers shop the like of which I have not seen in recent years. It was called a "cotter drill" and was made in Manchester, England. It was a very heavy machine and was semi-automatic in its action. The tool from which it received its name was a sort of two-lipped milling cutter instead of a drill and was sometimes called a "fish-tail" because of its resemblance to that well known appendage. Its work was the cutting of slots in flat bars of steel. Two such bars, 6 in. wide, 2 in. thick, and 10 or 12 ft. long would be mounted on the machine and a slot 2 in. wide by 6 in. long cut in one end and a series of shorter slots were cut in the other end.

How the Machine Worked

The workman would feed the drill down into the work to the proper depth of cut—determined by his judgment as to what the tool would stand—and then throw in a clutch which would cause the table to travel the desired distance to where a properly adjusted dog would disengage the feed. At this end the drill would be fed down some more and the clutch reversed, causing the table to travel back to the starting point.

These movements would be repeated until the tool was half through the work, when the latter would be turned over and the same operations gone through on the other side.

These pieces served as tie bars on the hydraulic wheel-presses used for pressing locomotive driving and car wheels on their axles. The reason for slotting them in pairs was to keep each pair exactly alike so that when the movable head of the wheel press was altered to suit different gages the draft would be evenly divided between the bars.

Got Tips From Apprentice Boy

As I stated above I first encountered the screw-cutting lathe in this shop, and I am indebted to an apprentice-boy who was running a similar lathe alongside me for many tips concerning its operation. We were both making bolts to be used on some parts of the firm's product and we were using, for the first time, the new snap gages

The bolts were to act as dowels and in consequence must be smooth and accurately to size. The boy seemed to be getting on finely; his bolts were smooth and apparently fitted his snap gage perfectly, while mine were not so smooth; causing the foreman, a very fussy individual, to give me quite a lecture on the desirability of perfect workmanship

The work did not pass through a separate inspection department as it would now, but each foreman was depended upon to keep the work from his department right. When the machines were assembled it was found that the bolts turned by my neighbor were too small.

Upon investigation it was found that the apprentice boy had turned his first bolt too small and in order to avoid explaining to the foreman, had squeezed the gage in a vise until it fitted the bolt. After that all gages were inspected after each man was through with them. The boy, who was an indentured apprentice, served out his time and in due course became a full-fledged mechanic. I have never seen him since but have seen many like him.

It was at the Sellers shop that I first saw hardened-steel bushings. These bushings were quite large, with holes in their walls for oil and dowels, and were ground inside and out. As the bushings were to go on a shaft between two solid collars, I wondered how they were ever going to get them to place. I was told that they were sawed in halves by a plain steel disk running at high rate of speed.

I did not see this operation and consequently know nothing of it but hearsay, but it was said that the disk went through the hardened bushings like a circular saw through wood. I do not know whether a lubricant was used or not. The disk was a trifle thicker at the periphery, thinning toward the center, and was run between two collars that were of such diameter as to allow only enough of the disk to project to reach through the wall of the bushings.

Closing Gates When Whistle Blows

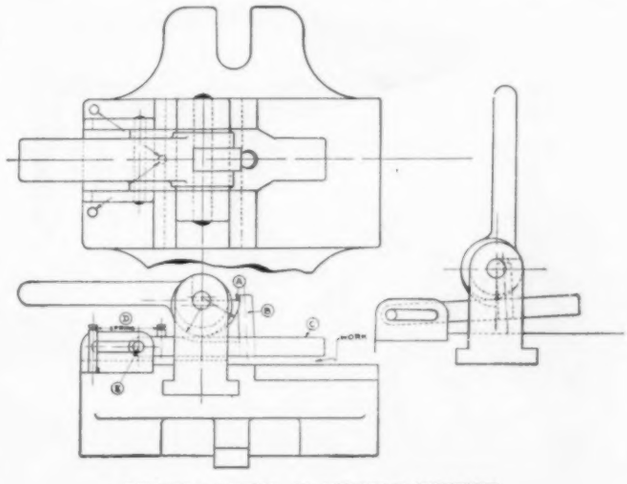
The Sellers company were very particular about promptitude in reporting for work, the gates being closed when the whistle blew, and any one coming after that was obliged to pass through the time-keeper's office; losing two and one-half hours from his pay.

The firm did not put any small change in the pay envelope. A running balance was kept on the books and the change paid to the workman each time it amounted to one dollar.

Double-Acting Clamping Device

By W. A. Anderson

The clamping device herewith illustrated provides a quick method of bringing the clamp over the work and clamping it simultaneously with one movement of the operating lever. The cam *A*, which is part of the eccentric cam for tightening, actuates the pin *B*, thus moving the clamping leaf forward. As the leaf *C* moves forward the eccentric cam presses it downward. The pin *E* acts as a pivot for the clamp leaf and also

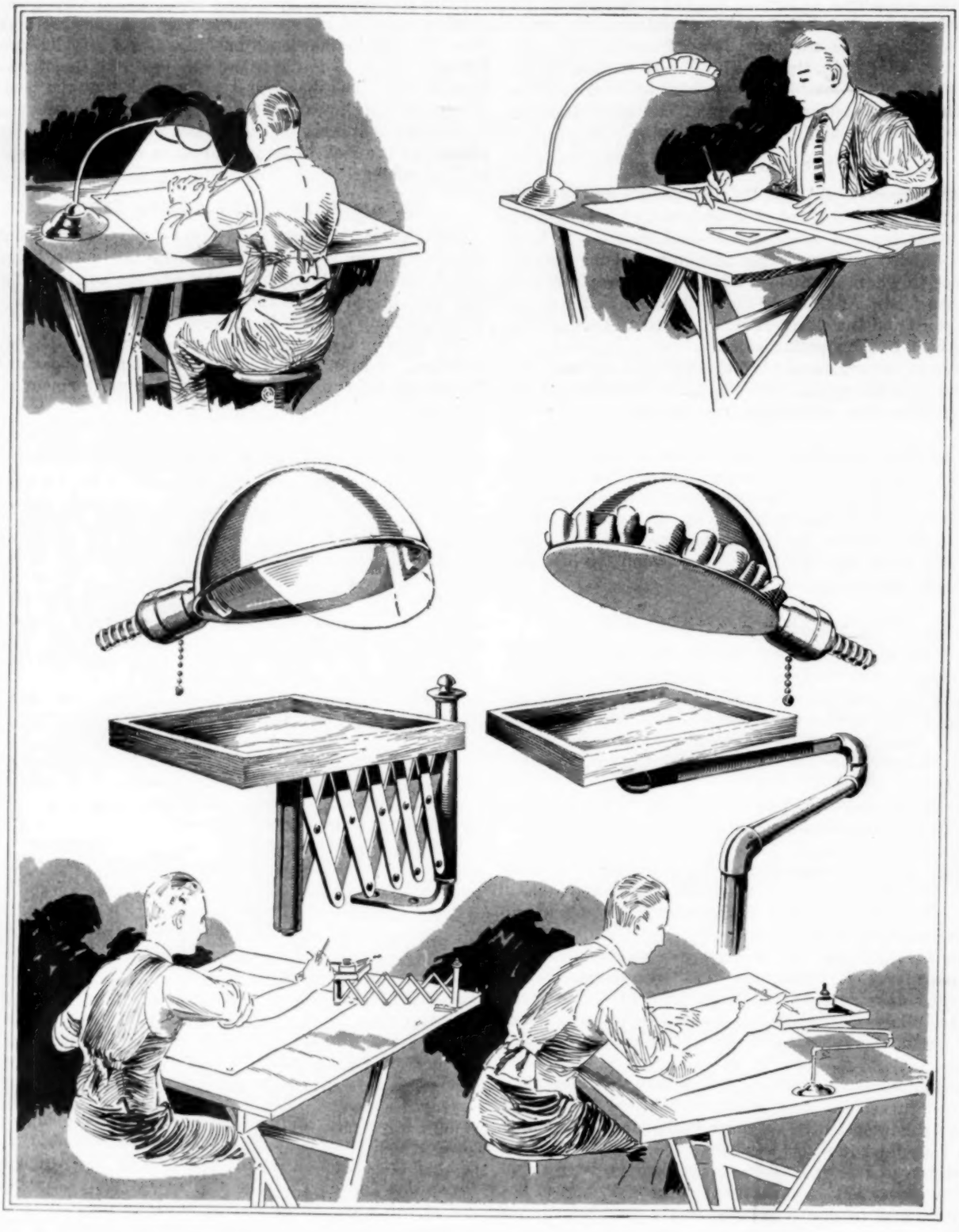


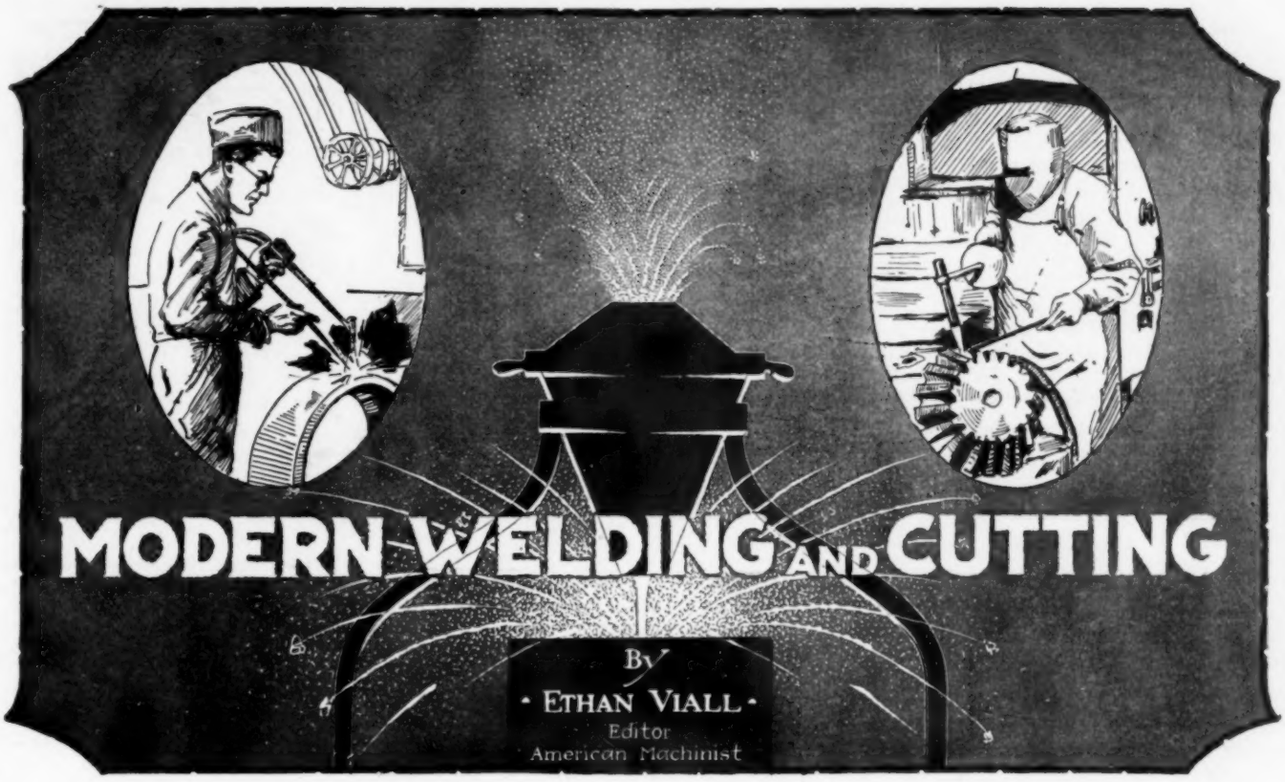
QUICK-ACTING CLAMPING DEVICE

guides it in its sliding movement. The springs *D* always hold the clamp leaf against the eccentric cam so that the clamp clears the work freely when moving forward. The view at the side shows the clamp back out of the way and illustrates how the pin enters the eccentric, thus providing the throw necessary to free it from the work.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas





Arc Welding Equipment*—XXVI†

ELECTRIC Arc Welding is the transformation of electrical energy into heat through the medium of an arc for the purpose of melting and fusing together two metals, allowing them to melt, unite, and then cool. The fusion is accomplished entirely without pressure. The heat is produced by the passage of an electric current from one conductor to another through air which is a poor conductor of electricity, and offers a high resistance to its passage. The heat of the arc is the hottest flame that is obtainable, carrying in temperature estimated to be between 3,500 and 4,000 deg C. (6,332 to 7,232 deg. F.).

The metal to be welded is made one terminal of the circuit, the other terminal being the electrode. By bringing the electrode into contact with the metal and instantly withdrawing it a short distance, an arc is established between the two. Through the medium of the heat thus produced, metal may be entirely melted away or cut, added to or built up, or fused to another piece of metal as desired.

A particularly advantageous feature of the electric arc weld is afforded through the concentration of this intense heat in a small area, enabling it to be applied just where it is needed.

Direct-current is now more generally used for arc welding than alternating-current.

When using direct-current, the metal to be welded is made the positive terminal of the circuit, and the electrode is made the negative terminal.

Regarding alternating-current it is obvious that an equal amount of heat will be developed at the work and at the electrode, while with direct-current welding we have considerably more heat developed at the positive terminal. Also in arc welding the negative electrode determines the character of the arc, which permits of making additions to the weld in a way that is not possible with alternating-current. Inasmuch as the work always has considerably greater heat-absorbing capacity than the electrode, it would seem only reasonable that the direct-current arc is inherently better suited for this work.

Two systems of electric arc welding, based on the type of electrode employed, are in general use, known as the carbon (or graphite) and the metallic electrode processes. The latter process is also sub-divided into those using the bare and the covered metallic electrodes.

A simple schematic layout for an arc-welding outfit is shown in Fig. 311.

The Carbon Electrode Process

In this process, the negative terminal or electrode is a carbon pencil from 6 to 12 in. in length and from ¼ to 1½ in. in diameter. This was the original process devised by Bernados and has been in more or less general use for more than thirty years. The metal is made the positive terminal as in the metallic electrode process in order that the greater heat developed in this terminal may be applied just where it is needed. Also, if the carbon were positive, the tendency would be for the carbon particles to flow into the weld and thereby make it hard and more difficult to machine.

The current used in this process is usually between 300 and 450 amp. For some special applications as high as from 600 to 800 may be required, especially if considerable speed is desired. The arc supplies the heat and the filler metal must be fed into the weld by hand from a metallic bar.

*For the author's forthcoming book, Welding and Cutting. All rights reserved.

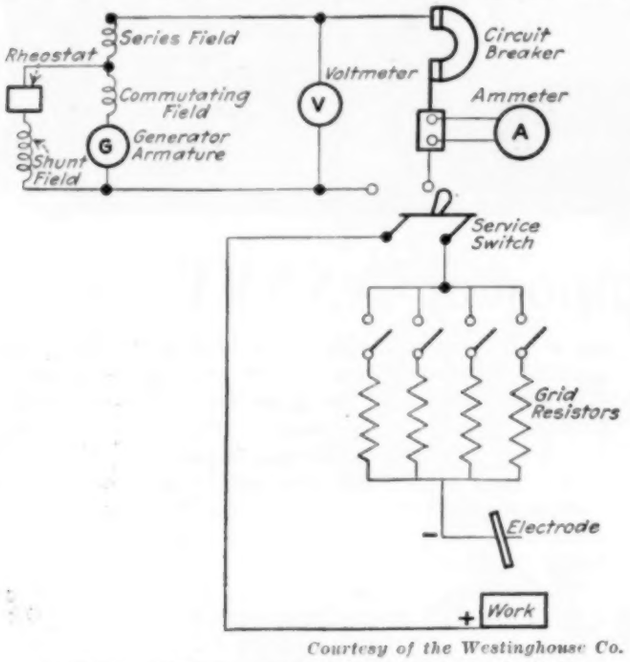
†Part XXV appeared in last week's issue.

The class of work to which the carbon process may be applied includes cutting or melting of metals, repairing broken parts and building up materials, but it is not especially adapted to work where strength is of prime importance unless the operator is trained in the use of the carbon electrode. It is not practical to weld with it overhead or on a vertical surface but there are many classes of work which can be profitably done by this process. It can be used very advantageously for improving the finished surface of welds made by metal electrodes. The carbon electrode process is very often useful for cutting cast iron and nonferrous metals, and for filling up blowholes.

The Metallic Electrode Process

In the metallic electrode process, a metal rod or pencil is made the negative terminal, and the metal to be welded becomes the positive terminal.

When the arc is drawn, the metal rod melts at the end and is automatically deposited in a molten state



Courtesy of the Westinghouse Co.

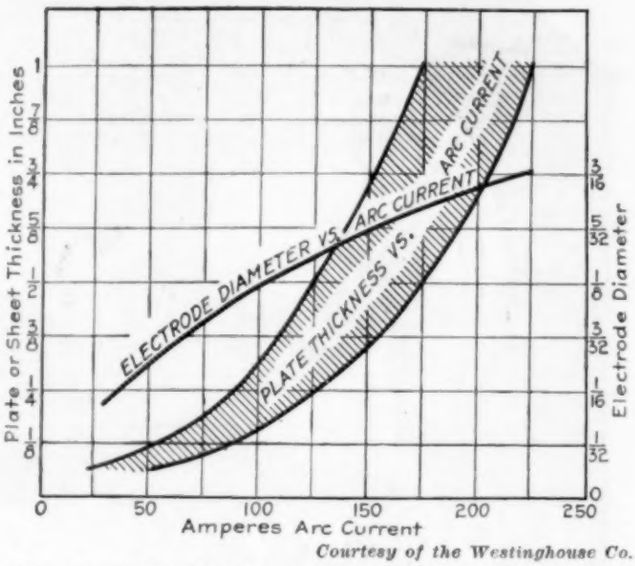
FIG. 311. SIMPLE SCHEMATIC WELDING CIRCUIT

in the hottest portion of the weld surface. Since the filler is carried directly to the weld, this process is particularly well adapted to work on vertical surfaces and to overhead work.

If the proper length of arc is uniformly maintained on clean work, the voltage across the arc will never greatly exceed 22 volts for bare electrodes and 35 volts for coated electrodes. The arc length will vary to a certain degree however, owing to the physical impossibility of an operator being able to hold the electrode at an absolutely uniform distance from the metal throughout the time required to make the weld.

It is very essential that the surfaces be absolutely clean and free from oxides and dirt, as any foreign matter present will materially affect the success of the weld.

When using a metallic electrode, the arc which is formed by withdrawing it from the work, consists of a highly luminous central core of iron vapor surrounded by a flame composed largely of oxide vapors. At the temperature prevailing in the arc stream and at the



Courtesy of the Westinghouse Co.

FIG. 312. RELATION OF APPROXIMATE ARC CURRENTS AND ELECTRODE DIAMETERS

electrode terminals, chemical combinations occur instantaneously between the vaporized metals and the atmospheric gases. These reactions continue until a flame of incandescent gaseous compounds is formed which completely envelopes the arc core. However, drafts created by the high temperature of the vapors and by local air currents tend to remove this protecting screen as fast as it is formed, making it necessary for the welder to manipulate the electrode so that the maximum protective flame for both arc stream and electrode deposit is continuously secured. This can be obtained automatically by the maintenance of a short arc and the proper inclination of the electrode towards the work in order to compensate for draft currents.

Selection of Electrodes

The use of a metallic electrode for arc welding has proved more satisfactory than the use of a carbon or graphite electrode which necessitates feeding the new metal or filler into the arc by means of a rod or wire. The chief reason for this is that, when the metallic electrode process is used, the end of the electrode is melted and the molten metal is carried through the arc to be deposited on the material being welded at the point where the material is in a molten state produced by the heat of the arc. Thus a perfect union or fusion is produced with the newly deposited metal.

Wire for metallic arc welding must be of uniform, homogeneous structure, free from segregation, oxides, pipes, seams, etc. The commercial weldability of electrodes should be determined by means of tests per-

PLATE THICKNESS IN INCHES	CURRENT IN AMPERES	ELECTRODE DIAMETER IN INCHES
1/16	20 to 50	1/16
1/8	50 to 85	3/32
3/16	75 to 110	1/8
1/4	90 to 125	1/8
3/8	110 to 150	5/32
1/2	125 to 170	5/32
5/8	140 to 185	5/32
3/4	150 to 200	3/16
7/8	165 to 215	3/16
1	175 to 225	3/16

TABLE XXIV. APPROXIMATE CURRENT VALUES FOR PLATES OF DIFFERENT THICKNESS

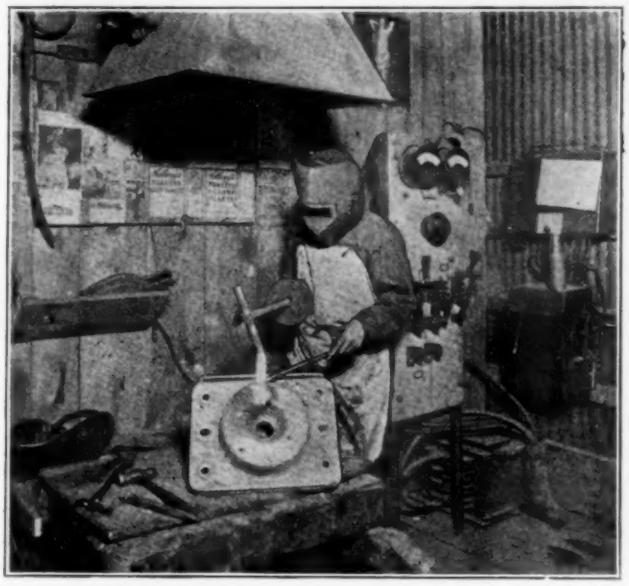


FIG. 313. CARBON-ARC WELDING, USING KING MASK

formed by an experienced operator, who can ascertain whether the wire flows smoothly and evenly through the arc without any detrimental phenomena.

The following table indicates the maximum range of the chemical composition of bare electrodes for welding mild steel:

Carbon trace up to	0.25%
Manganese trace up to	0.99%
Phosphorous not to exceed	0.05%
Sulphur not to exceed	0.05%
Silicon not to exceed	0.08%

The composition of the mild steel electrodes, commonly used, is around 0.18 per cent carbon, and manganese not exceeding 0.5 per cent, with only a trace of phosphorus, sulphur and silicon.

The size, in diameter, ordinarily required will be $\frac{1}{8}$ in., $\frac{5}{32}$ in., and $\frac{3}{16}$ in. and only occasionally the $\frac{1}{4}$ in.

These electrodes are furnished by a number of firms, among whom are John A. Roebling's Sons Co., Trenton, N. J.; American Rolling Mills Co., Middletown, Ohio; American Steel and Wire Co., Pittsburgh, and Ferride Electric Welding Wire Co., New York City; Page Woven Wire Co., Monessen, Pa.; John Potts Co., Philadelphia.

A coated electrode is one which has had a coating of some kind applied to its surface for the purpose of totally or partially excluding the atmosphere from the metal while in a molten state when passing through the arc and after it has been deposited.

The proper size of electrode may be determined from Fig. 312 from which it will be seen that the class of work, and current used are both factors determining the size of the electrode for welding steel plates of various thicknesses. To find the diameter of the metallic electrode required, select, for example, a three-eighths plate, and follow horizontally to the "Thickness of the Plate Curve." The vertical line through this intersection represents about 110 amp. as the most suitable current to be used with this size of plate. Then follow this vertical line to its intersection with the "Diameter of Electrode" curve which locates a horizontal line representing approximately an electrode $\frac{5}{32}$ in. in diameter. In a similar manner, a $\frac{1}{4}$-in. plate requires about 125 amp. and a $\frac{5}{32}$-in. electrode.

The amount of current to be used is dependent on the thickness of the plate to be welded when this value is $\frac{3}{4}$ in. or less. Average values for welding mild steel plates with direct current are indicated by the curve referred to above in connection with the selection of the electrode of proper size. This data is also shown in table XXIV.

It should be borne in mind, however, that these values are only approximate as the amount of current to be used is dependent on the temperature of the plate and also upon the type of joint. For example, when making a lap weld between two $\frac{1}{2}$-in. steel plates at ordinary air temperature of about 65 deg. F. it has been found that the extra good results were obtained by using a current of about 225 amp. and a $\frac{5}{16}$-in. diameter electrode. The explanation for the high current permissible is the tremendous heat storage and dissipation capacity of the lapped plates which makes the combination practically equivalent to that of a butt weld of two 1-in. plates. For that reason the above values will be very greatly increased in the case of lap welds which require practically twice the amount of current taken by the butt welds.

When the proper current value is used there will be a crater, or depression, formed when the arc is interrupted. This shows that the newly deposited metal is penetrating or "biting into" the work.

The difference between the carbon and the metallic electrode processes can be seen in Figs. 313 and 314. In Fig. 313 the welder is using a carbon electrode and feeding metal into the weld from a metal rod held in his left hand. In Fig. 314 the metal rod is held in a special holder and not only carries the current but metal from it is deposited on the work.

Electrode holders should be simple, mechanically strong, and so designed as to hold the electrode firmly. It should be practically impossible to burn or damage the holder by accidental contact so that it will not work. Small, flimsy or light projecting parts are almost sure to be broken off or bent. Fig. 315 shows one of these holders that answers the requirements. However, any of the companies selling arc welding apparatus will be able to supply dependable holders.

A holder made by the Arc Welding Machine Co., New York, is shown in Fig. 316 and in detail in Fig. 317. The metal rod is clamped in by means of an eccentric segment operated by a thumb lever. If the rod should freeze to the work it will not pull out of the holder, but

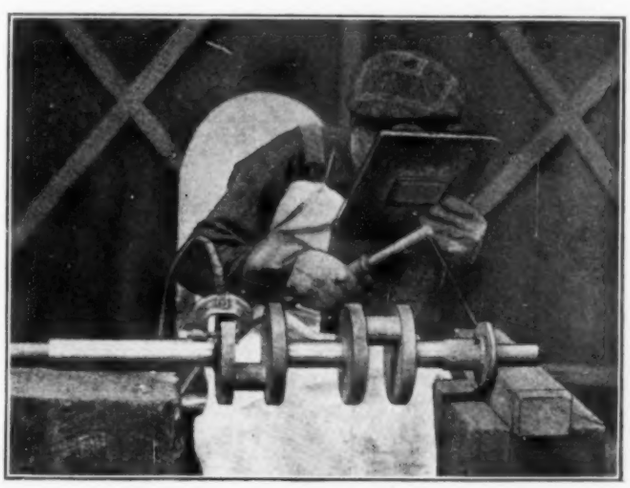


FIG. 314. METALLIC-ARC WELDING, USING A HAND SHIELD

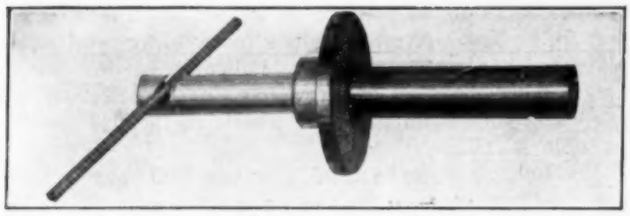


FIG. 315. SIMPLE FORM OF ELECTRODE HOLDER

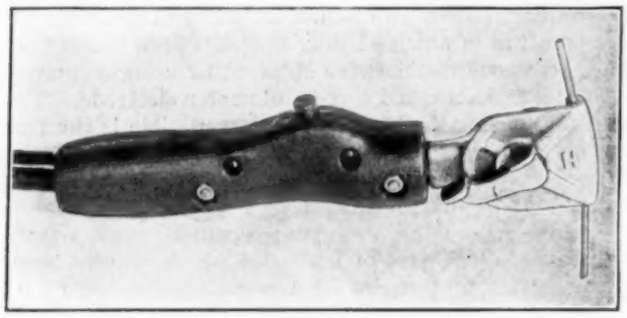


FIG. 316. SPECIAL MAKE OF ELECTRODE HOLDER

will be gripped all the tighter. The welding current enters at the rear end of the composition shank, passes along the shank to the head of the tool, and from there directly into the electrode. It will be noted, that there are no joints in this tool except where the cable is soldered into the shank. There is a relatively large contact surface between the electrode and the holding head, which precludes any possible heating at this point. The trigger is intended for remote control employed with the closed-circuit system. Whenever this holder is used on other systems, the trigger is omitted.

CABLE

For arc welding service the cables leading to the electrode holder should be very flexible in order to allow the operator full control of the arc.

The following sizes of cable have been found by the General Electric Co., suitable for this service, due account being taken of the intermittent character of the work.

It is extra flexible stranded dynamo cable, insulated for 75-v. circuit, with varnished cambric insulation, covered with weatherproof braid.

Amperes	Size of Cable	Circular Mills
Up to 200	225/24	90,000
Over 200 Up to 500	375/24	150,000
Over 500 Up to 1,000	650/24	260,000

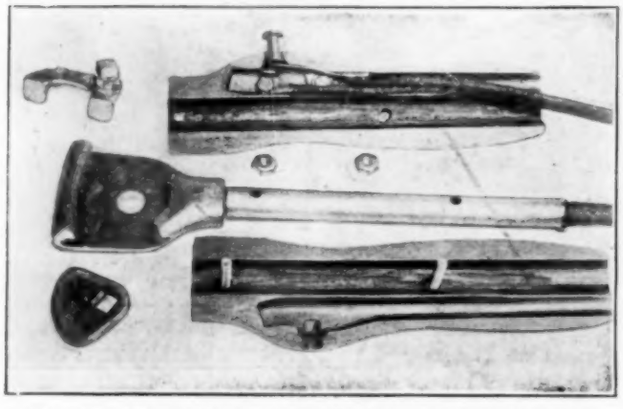


FIG. 317. DETAILS OF SPECIAL ELECTRODE HOLDER

FIG. 318. KING FACE MASKS WITH AND WITHOUT SIDE SCREENS

It will be noted in Figs. 313 and 314, that two different ways of protecting the eyes are shown. One man has a helmet and the other uses a shield held in the hand. Conditions under which the welders work, and their personal preferences, largely dictate which type is to be used. However, no welder should ever attempt arc welding without a protecting screen fitted with the right kind of glass. Cheap glass is dear at any price, for the light rays thrown off from the arc are very dangerous to the eyesight. The guard should be so made as to not only protect the eyes from dangerous light rays, but should also protect the face and neck from flying sparks of metal.

A very good face mask made by Julius King Optical Co., New York, is shown in Fig. 318. These masks are made of fiber and provision is made for a free circulation of air between the front and the face, not only keeping the operator cool, but preventing the tendency of the lenses to fog. The masks are supported by bands over the head and it is said that weight is not apparent and that they are as comfortable to wear as a cap. Two styles are made—with and without side screens. The one without screens may be had with combination lenses tinted for acetylene or electric welding or with any other tint for specific work. The one with side screens, providing side vision, is fitted either with combination lenses or with clear Saniglass lenses. A hand shield is shown in Fig. 319.

In arc welding in the open, other workmen or onlookers are liable to injury as well as the welders, so screens should be placed around the work to conceal the light rays from the view of others besides the welder. Such an arrangement is shown in Fig. 320.

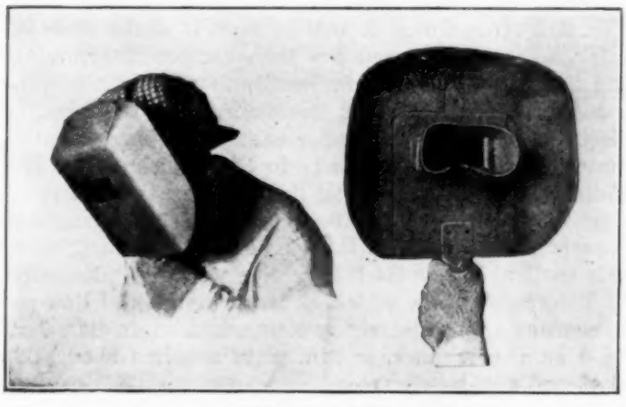


FIG. 319. KING HAND SHIELDS

Where repetition work is to be done, it is well to provide individual stalls or booths, somewhat similar to the one shown in Fig. 321. These were designed for use in the welding schools under the supervision of the Lincoln Electric Co. For actual shop work, curtains or screens should be provided back of the welders.

It must be remembered also, that owing to the presence of ultra-violet rays, severe flesh burns may result with some people if proper gloves and clothing are not worn—especially when using the carbon arc.

Selecting a Welding Outfit

Welding outfits may be of the stationary or the portable type. These may also be divided into motor-generator sets and the "transformer" types. Both d.c. and a.c. current may be used primarily, depending on the apparatus employed and the source of current available.

Regarding the selection of any particular outfit J. M. Ham, writing in the *General Electric Review* for December, 1918, says:

"Few things electrical have in so short a period of time created such wide-spread interest as that of arc welding. Engineers having to do with steel products, in whatever form produced or in whatever way employed, have investigated its uses not only as a building agent when applied to new material but as a reclaiming agent for worn or broken parts. In both cases its possibilities as a means of greatly increasing output and in saving otherwise useless parts at a small fraction of their original or replacement value has proved astounding.

Out of these investigations have grown several systems of arc welding that may be designated as, constant potential, constant energy and alternating current.

To exploit these is the duty of the sales department and the measure of its success depends upon the quality of service rendered.

The difficulties of giving service are perhaps not fully appreciated. Where so many systems have been called for and where so many individual ideas have to be met, the problems of the manufacturer become multiplied.

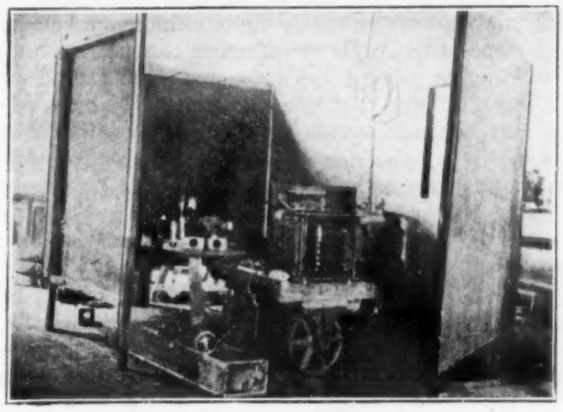


FIG. 320. METHOD OF USING SCREENS TO PROTECT OTHERS

During a period of freight congestion when locomotives were in unprecendented demand, an engine was run into the repair shop with slid flat spots on each of the eight driving wheels, and orders were issued to return it ready for service in record time. In three hours repairs had been completed by means of the electric arc (to have put on new tires would have required three to four days) and the locomotive was out on the road. Many other achievements as remarkable as these have been obtained.

It would seem that having demonstrated the success of arc welding for a given line of work, others similarly engaged would be keen to take advantage of it; but that is true only in part, possibly because this is a "show me" age.

When it becomes apparent to the investigator of arc welding possibilities that the process fulfills his require-

FIG. 321. INDIVIDUAL STALLS FOR INSTRUCTION WORK

ments, the question of what system to employ confronts him; salesmen are on the job to tell him about their particular specialties. He is informed that the real secret of welding is having the proper electrode (the salesman's special kind); it must be covered or bare, as the case may be, and contain certain unnamed ingredients. The merits of the direct-current system are extolled. Alternating-current outfits are advocated by others, it being claimed that they bite deeper and weld if the arc is held. The prospective buyer retires with a headache to think it over.

There is no mystery about arc welding. It is being done with all sorts of outfits and many varieties of electrodes. It can even be done from power lines with resistance in series with the arc. But these systems differ widely in essentials, just as in the case of automobiles. We can buy a cheap car or an expensive car, and in either event we get just about what we pay for.

The arc-welding set must pay its way. It must earn dividends and conserve materials, and when properly selected and applied does both of these things to a degree quite gratifying. To the discriminating purchaser it is not sufficient merely to know that an outfit will make a weld, he wants to know if it is the best weld that can be made, if it can be made in the shortest possible time, and whether the ratio between cost of the entire system to the savings effected is the lowest obtainable. He doubtless will, if the work is of sufficient magnitude to warrant, establish a welding department with a trained arc welding man in charge, and see that this department stands on its own feet. By so doing he places responsibility on a man who knows what to do and how to do it—a friend rather than a foe of the system. He will, other things being anything like equal, respect the opinion of the operator in the selection of the system to be employed, because it is better to provide a man with tools he is familiar with and prefers to use, rather than to force him to use something with which he is unfamiliar or which he regards with disfavor.

Obviously, the purchaser wishes to know that the companies he is dealing with are reliable and responsible, that the experience back of the salesmen is sufficient to warrant faith in his product. It is important to know the amount of power required per operator and whether drawing the needed amount from his own lines or from those of the power company will interfere with the system, and if so to what extent, and what, if any, additional apparatus will be needed to correct the trouble. Having determined these things to his satisfaction, he can install his arc-welding system with a considerable degree of assurance that there will be a decided saving in time, men, and money, and a genuine conservation of materials.

Checking Up On Accidents

By H. P. Heyne
Safety Inspector, United Alloy Steel Corporation, Canton, Ohio

When it is found that injuries are more frequent in one department than in others where similar work is performed, the correction of this situation may require special examination into the conditions and the manner in which the work is performed, careful study of the employees engaged in the work, and the introduction of special safety requirements. These may result in change in the method of handling the material; special precautionary measures; closer observance by foremen over the men; better maintenance of tools, etc. Departmental and occupational injury statements and charts visualize existing conditions and show up the "high spots" or peaks to be investigated.

The foremen should be able to give enthusiastic assistance in securing the support of the workmen in accident prevention. The prevention itself can be accomplished by the safety engineer, but he must win to his viewpoint the foremen and working force. The enthusiasm should be contagious, from the officials and department heads down to the workmen, joining them in accident-prevention activities.

Safety work is a business proposition, to both employer and employee. The employer is benefited through increased production and decreases in spoilage, hospital expense and compensation. The employee and his family are spared hardships, misery and suffering, through his not being incapacitated, and he is able to maintain a livelihood through non-interruption of employment, and increase in his earning power due to increased efficiency. Safety Engineering might well be considered a producing unit in an establishment, for its activities have a direct bearing on production and efficiency.

Classification of Injuries

A monthly report showing the classification by departments, as to causes of injuries, acts as a stimulus, among the department heads, to reduce the number on the subsequent reports. The causes for injuries would vary in accordance with the class of work in the establishment. There are, however, general causes which are applicable to most industries, such as: 1. Foreign bodies in eye (from grinding wheels from chipping; hot material; sparks). 2. Burns (from hot metal, slag, water, steam, acid, electricity, babbitt). 3. Handling material (loading; unloading; piling; removing from piles; conveying). 4. Objects falling (over; falling from overhead; falling into pits). 5. Hand tools (hammers; sledges; picks; crow bars). 6. Machinery (gears; machines; machinery tools; winches). 7. Transmission (pulleys; belts; shafting; setscrews). 8. Persons falling (slipping or tripping; falling into openings, pits or stairways; from ladders; over material on floors and in yards). 9. Stepping on or striking against objects (sharp objects; slivers; scrap; glass; protruding nails). This list is by no means complete, but it shows how injuries may be classified for analytical purposes, which is a necessary procedure to successfully attack the causes for injuries.

Inquiries Reported to Employment Department

A monthly compilation of lost-time injuries, showing the employee's name, check number, nature of injury, days lost, etc., may be furnished the employment department, so that injuries may be recorded in the employment files. In this manner, the records will show how often an employee has suffered injuries and when it is observed that he has sustained a number of injuries involving loss of time, it will be a cue for a further investigation. Such an employee may not be competent for the place he is filling, and it may be better to transfer him to another position, resulting in a saving to the company and benefitting the worker.

National Screw Thread Commission Reports on Coarse and Fine Threads—Part II

Part I defined and classified the coarse and fine threads recommended by the commission, specified the tolerances for nut and screw and outlined the gages to be used. Part II, which concludes the article, specifies the gages in detail, supplies tables of manufacturing tolerances for them and includes typical specifications for screw-thread productions.

(Part I appeared last week.)

THE general subject of gaging screws is too extensive to be fully covered in this report. Reference is made, however, to bulletins published by the Bureau of Standards covering various inspection methods, including the standard ring and plug gages, and the optical projection method of gage inspection; also, to an article in the *Journal* of American Society of Mechanical Engineers of February, 1919, with reference to the use of the projection lantern for gaging work.

Inasmuch as the threaded plug and ring limit gage is the most universally used scheme of gaging, and one that has been brought to the highest state of refinement, there is set forth herein what is considered the best practice used in the production and use of such gages. It is understood, however, that it is not the intention of this commission to confine manufacturers to any particular method of gaging, as that would tend to hinder progress.

It has been the practice of many manufacturers, including Government shops, to work with "Go" gages only and to depend upon the judgment of a good workman to keep within proper limits by the amount of "shake" or difference between the work and the gage. With a highly skilled and trained force working on but one kind of work and also referring the working gage to but one master gage, a fair degree of interchangeability can be maintained under these conditions.

In the recent military preparations, the Government required munitions in such vast quantities and in such a short period of time that this method of insuring interchangeability failed, and a method of gaging had to be established which did not rely entirely upon the skill and judgment of the workmen or inspectors. One reason for the necessity of a complete gaging system was that it was not possible to obtain a sufficient number of skilled workmen or inspectors. Furthermore, one master gage could not be used all over the country and consequently discrepancies in measurement between different shops had to be guarded against by the use of properly tested standards and by approved methods of measuring.

It is believed that the experience gained by manufacturers producing war material will result in a much more extensive use of gages than was ever thought practicable during pre-war times. The gage specifications which are given herein cover the manufacture, use and application of a system of gaging which has been thoroughly demonstrated in the execution of war contracts as being adequate for the production in large quantities of strictly interchangeable screw-thread product. It is not the intention of this report to limit manufacturers to any particular methods of test in checking either the manufactured product or in measuring gages, for the reason that any specification which would tend to limit the development of new and improved methods of measuring would be very undesirable. However, when the ordinary forms of thread gages are used, the specifications given herein will apply.

Gages and Methods of Test

The specifications for gages given herein are built upon the following fundamental assumptions:

Approved limit master gages do not reduce the net working tolerance. Permissible errors in *angle of thread* specified for "Go" gages tend to reduce the net working tolerance, while similar permissible errors on the "Not Go" gage tend to increase the net working tolerance. These two factors, therefore, balance each other. Permissible *lead errors* specified for the "Go" gage reduce the net working tolerance, while permissible lead errors on the "Not Go" gage tend to increase the net working tolerance. In order to realize the full net working tolerance, the permissible diametrical variation specified for both "Go" and "Not Go" gages (gage increment) is placed outside of the net tolerance limits. The extreme tolerance equals the net tolerance plus gage increment. The "Go" gage should check simultaneously all elements of the thread (all diameters, lead, angle, etc.) The "Not Go" gage should check separately the elements of the thread.

The following general specifications refer in particular to gaging systems which have been found satisfactory by the Army and Navy for the production of interchangeable parts as specified under the subject of "Classification and Tolerances." These specifications are included for the use of manufacturers where definite information is lacking. They are not to be considered mandatory.

Thread gages may be included in one of four classes, namely, Standard Master Gages, Limit Master Gages, Inspection Gages, and Working Gages.

The Standard Master Gage is a threaded plug representing as exactly as possible all physical dimensions of the nominal or basic size of the threaded component. In order that the Standard Master Gage be authentic, the deviations of this gage from the exact standard should be ascertained by the National Bureau of Standards and the gage should be used with knowledge of these deviations or corrections.

Limit Master Gages are for reference only. They represent the extreme upper and lower tolerance limits allowed on the dimensions of the part being produced. They are often of the same design as inspection gages. In many cases, however, the design of the master gage is that of a check which can be used to verify the inspection or working gage.

Inspection Gages are for the use of the purchaser in accepting the product. They are generally of the same design as the working gages and the dimensions ar such that they represent nearly the net tolerance limits on the parts being produced. Inasmuch as a certain amount of wear must be provided on an inspection gage, it can not represent the net tolerance limit until it is worn to master gage size.

Working Gages are those used by the manufacturer to check the parts produced as they are machined. It is recommended that the working gages be made to represent limits considerably inside of the net limits in order that sufficient wear will be provided for the working gages, and in order that the product accepted by the working gages will be accepted by the inspection gages.

The following list enumerates the inspection and working gages required for producing strictly interchangeable

screws as specified for National Coarse Threads, National Fine Threads, or other straight threads.

a. A maximum or "Go" ring thread gage, preferably adjustable, having the required pitch diameter and minor diameter. The major diameter may be cleared to facilitate grinding and lapping.

b. A minimum or "Not Go" ring thread gage, preferably adjustable, to check only the pitch diameter of the threaded work.

c. A maximum or "Go" plain ring gage to check the major diameter of the threaded work.

d. A minimum or "Not Go" snap gage to check the major diameter of the threaded work.

The following list enumerates the inspection and working gages required for producing strictly interchangeable nuts, as specified for National Coarse Threads, National Fine Threads, or other straight threads.

a. A minimum or "Go" thread plug gage of the required pitch diameter and major diameter. The minor diameter of the thread plug gage may be cleared to facilitate grinding and lapping.

b. A maximum or "Not Go" thread plug gage to check only the pitch diameter of the threaded work.

c. A "Go" plain plug gage to check the minor diameter of the threaded work.

d. A "Not Go" plain plug gage to check the minor diameter of the threaded work.

The following list enumerates the limit master gages required for the verification of the working or inspection gages as previously listed for verifying the screw.

a. A set plug or check for the maximum "Go" thread ring gage, having the same dimensions as the largest permissible screw.

b. A set plug or check for the minimum or "Not Go" thread ring gage having the same dimensions as the smallest permissible screw.

c. A maximum plain plug for checking the minor diameter of both the "Go" and "Not Go" inspection thread ring gage.

The following list enumerates the limit master gages required for the verification of the working or inspection gages as previously listed for verifying the nut.

a. A minimum or "Go" threaded plug to be used as a reference for comparative measurements, corresponding to the basic dimension, or standard master gage.

b. A maximum or "Not Go" threaded plug to be used as a reference for comparative measurements, corresponding to the largest permissible threaded hole.

c. A minimum plain ring gage to check the major diameter of the "Go" and "Not Go" master threaded plug unless suitable measuring facilities are available for this purpose.

Gages may be made of a good grade of machinery steel pack-hardened, or of straight carbon steel of not less than 1 per cent carbon; or preferably of an oil hardening steel of approximately 1.10 per cent carbon and 1.40 per cent chromium.

Handles should be made of a good grade of machinery steel plainly marked to identify the gage.

The following specifications will be helpful in the design and construction of gages used for producing threaded work.

All plain plug gages should be single-ended. Plain plug gages of 2 in. and less in diameter should be made with a plug inserted in the handle and fastened thereto by means of a pin. Plain plug gages of more than 2 in. in diameter should have the gaging blank so made as to be reversible. This can be accomplished by having a finished hole in the gage blank fitting a shouldered projection on the end of the handle, the gage blank being held on with a nut.

The "Go" plain plug gage should be noticeably longer than the "Not Go" plain plug gage, or some distinguishing feature in the design of the handle should be used to serve as a ready means of identification, such as a chamfer on the handle of the "Go" gage.

Both the "Go" and the "Not Go" gages should have their outside diameters knurled if made circular.

The "Go" gage should have a decided chamfer in order to provide a ready means of identification for distinguishing the "Go" from the "Not Go" gage.

Snap gages may be either adjustable or non-adjustable. It is recommended that all snap gages up to and including ¾ in. be of the built-up type. For larger snap gages, forged blanks, flat plate stock or other suitable construction may be used.

Sufficient clearance beyond the mouth of the gage should be provided to permit the gaging of cylindrical work.

Snap gages for measuring lengths and diameters may have one gaging dimension only, or may have a maximum and minimum gaging dimension, both on one end, or maximum and minimum gaging dimensions on opposite ends of the gage. When the maximum and minimum gaging dimensions are placed on opposite ends of the gage, the maximum or "Go" end of the snap gage will be distinguished from the minimum or "Not Go" end by having the corners of the gage on the "Go" end decidedly chamfered.

All plug thread gages should be single-ended. Thread plug gages 2 in. and less in diameter should be made with a plug inserted in a handle and fastened thereto by means of a pin.

Plug gages of more than 2 in. in diameter, unless otherwise specified, should have the gaging blank so made as to be reversible. This can be accomplished by having the finished hole in the gage blank fitting a shouldered projection on the end of the handle, the gage blank being keyed on and held with a nut.

"Not Go" thread plug gages should be noticeably shorter than the "Go" thread plug gages, in order to provide a ready means of identification, or the handle of the "Go" gage should be chamfered.

End threads on plug thread gages should not be chamfered, but the first half turn of the end thread should be flattened to avoid a feather edge.

Inspection and working thread plug gages should be provided with dirt grooves which extend into the gage for a depth of from one to four threads.

The length of thread parallel to the axis of the gage should, for all standard "Go" thread plug gages, be at least as much as the quantity expressed in the following formula:

$$L = (1.5)\ D$$

Where L = Length of thread

D = Basic major diameter of thread.

For threaded work of shorter length of engagement than (1.5) D, the length of thread on the "Go" gage may be correspondingly shorter.

"Not Go" Thread Gage for Pitch Diameter Only: All "Not Go" thread plug gages should be made to check the pitch diameter only. This necessitates removal of the crest of the thread so that the dimension of the major diameter is never greater than that specified for the "Go" gage, and also removing the portion of the thread at the root of the standard thread form.

All ring thread gages should be made adjustable.

The "Go" gage should be distinguished from the "Not Go" gage by having a decided chamfer and both gages are to have their outside diameter knurled if made circular.

The end threads on ring thread gages should not be chamfered but the first half turn of the end thread should be flattened to avoid a feather edge.

The length of thread parallel to the axis of the gage should, for all standard "Go" ring thread gages, be at least as great as the quantity determined in the formula previously given. For threaded work of shorter length of engagement than (1.5) D, the length of thread on the "Go" gage may be correspondingly shorter.

"Not Go" ring thread gages should be made to check the pitch diameter only. This necessitates removal of the crest of the thread so that the dimension of the minor diameter is never less than that specified for the maximum or "Go" gage and also removing the portion of the thread at the root of the standard form. There are specified herein for use in the production of National Coarse Threads and National Fine Threads, and for other straight threads, several tables of gage manufacturing tolerances.

TABLE VII. MANUFACTURING TOLERANCES ON PLAIN GAGES

Manufacturing Tolerance Allowed on Work	Allowable Tolerance for Master Gages		Allowable Tolerance for Inspection Gages		Suggested Tolerance for Working Gages	
	Minimum Gage	Maximum Gage	Minimum Gage	Maximum Gage	Minimum Gage	Maximum Gage
0.002.....	+0.0000 +0.0001	—0.0000 —0.0001	+0.0001 +0.0003	—0.0001 —0.0003	+0.0003 +0.0005	—0.0003 —0.0005
0.002 to 0.004	+0.0000 +0.0002	—0.0000 —0.0002	+0.0002 +0.0004	—0.0002 —0.0004	+0.0004 +0.0007	—0.0004 —0.0007
0.004 to 0.006	+0.0000 +0.0003	—0.0000 —0.0003	+0.0004 +0.0007	—0.0004 —0.0007	+0.0007 +0.0011	—0.0007 —0.0011
0.006 to 0.010	+0.0000 +0.0004	—0.0000 —0.0004	+0.0006 +0.0010	—0.0006 —0.0010	+0.0010 +0.0015	—0.0010 —0.0015
0.010 to 0.020	+0.0000 +0.0005	—0.0000 —0.0005	+0.0010 +0.0015	—0.0010 —0.0015	+0.0015 +0.0021	—0.0015 —0.0021
0.020 to 0.050	+0.0000 +0.0006	—0.0000 —0.0006	+0.0020 +0.0026	—0.0020 —0.0026	+0.0026 +0.0033	—0.0026 —0.0033

TABLE VIII. TOLERANCES ON MASTER THREAD GAGES FOR LOOSE FIT AND MEDIUM FIT WORK

(This applies to both Standard and Limit Master Gages)

Number of Threads per Inch	Allowable Variation in Lead Between Any Two Threads Not Farther Apart than Length of Engagement	Allowable Variation in One-half Angle of Thread Gages	Allowable Tolerances on Diameters of Minimum Thread Gages	Allowable Tolerances on Diameters of Maximum Thread Gages
4 to 6	±0.0005	±0° 5′	+0.0000 +0.0006	—0.0000 —0.0006
7 to 10	±0.0004	±0° 5′	+0.0000 +0.0004	—0.0000 —0.0004
11 to 18	±0.0003	±0° 10′	+0.0000 +0.0004	—0.0000 —0.0004
20 to 28	±0.0002	±0° 15′	+0.0000 +0.0003	—0.0000 —0.0003
30 to 40	±0.0002	±0° 20′	+0.0000 +0.0002	—0.0000 —0.0002
44 to 80	±0.0002	±0° 30′	+0.0000 +0.0002	—0.0000 —0.0002

TABLE IX. SUGGESTED MANUFACTURING TOLERANCES FOR INSPECTION GAGES FOR LOOSE FIT AND MEDIUM FIT WORK

Number of Threads per Inch	Allowable Variation in Lead Between Any Two Threads Not Farther Apart than Length of Engagement	Allowable Variation in One-half Angle of Thread Gages	Allowable Tolerances on Diameters of Minimum Thread Gages	Allowable Tolerances on Diameters of Maximum Thread Gages
4 to 6	±0.0006	±0° 5′	+0.0006 +0.0015	—0.0006 —0.0015
7 to 10	±0.0005	±0° 10′	+0.0004 +0.0010	—0.0004 —0.0010
11 to 18	±0.0004	±0° 15′	+0.0004 +0.0008	—0.0004 —0.0008
20 to 28	±0.0003	±0° 20′	+0.0003 +0.0006	—0.0003 —0.0006
30 to 40	±0.0002	±0° 30′	+0.0002 +0.0005	—0.0002 —0.0005
44 to 80	±0.0002	±0° 45′	+0.0002 +0.0004	—0.0002 —0.0004

TABLE X. SUGGESTED MANUFACTURING TOLERANCES FOR WORKING GAGES FOR LOOSE FIT AND MEDIUM FIT WORK

Number of Threads per Inch	Allowable Variation in Lead Between Any Two Threads Not Farther Apart than Length of Engagement	Allowable Variation in One-half Angle of Thread Gages	Allowable Tolerances on Diameters of Minimum Thread Gages	Allowable Tolerances on Diameters of Maximum Thread Gages
4 to 6	±0.0006	±0° 5′	+0.0015 +0.0025	—0.0015 —0.0025
7 to 10	±0.0005	±0° 10′	+0.0010 +0.0020	—0.0010 —0.0020
11 to 18	±0.0004	±0° 15	+0.0008 +0.0015	—0.0008 —0.0015
20 to 28	±0.0003	±0° 20′	+0.0006 +0.0012	—0.0006 —0.0012
30 to 40	±0.0002	±0° 30′	+0.0005 +0.0010	—0.0005 —0.0010
44 to 80	±0.0002	±0° 45′	+0.0004 +0.0006	—0.0004 —0.0006

TABLE XI. MASTER GAGE TOLERANCES FOR CLASS III, CLOSE FIT WORK

(This applies to both Standard and Limit Master Gages)

Number of Threads per Inch	Allowable Variation in Lead Between Any Two Threads Not Farther Apart than Length of Engagement	Allowable Variation in One-half Angle of Thread Gages	Allowable Tolerances on Diameters of Minimum Thread Gages	Allowable Tolerances on Diameters of Maximum Thread Gages
4 to 6	±0.00025	± 2′ 30″	+0.00000 +0.00030	—0.00000 —0.00030
7 to 10	±0.00020	± 2′ 30″	+0.00000 +0.00020	—0.00000 —0.00020
11 to 18	±0.00015	± 5′ 00″	+0.00000 +0.00020	—0.00000 —0.00020
20 to 28	±0.00010	± 7′ 30″	+0.00000 +0.00015	—0.00000 —0.00015
30 to 40	±0.00010	±10′ 00″	+0.00000 +0.00010	—0.00000 —0.00010
44 to 80	±0.00010	±15′ 00″	+0.00000 +0.00010	—0.00000 —0.00010

Table VII will be found practicable for all plain plug, ring and snap gages used in connection with a measurement of screw thread diameters. In addition to the master gage tolerances, suggested tolerances for inspection and working gages are also given in Table VII.

Table VIII will be found practicable for both standard and limit master thread gages for thread work designed in accordance with the manufacturing tolerances for Class I, Loose Fit, and Class II, Medium Fit, made to Tables III, IV and V.

Table IX contains suggested manufacturing tolerances for inspection thread gages with a small allowance for wear for use in quantity production of Class I, Loose Fit, and Class II, Medium Fit thread work, made to Tables III, IV and V.

Table X contains suggested manufacturing tolerances for working thread gages with a small allowance for wear for use in quantity production of Class I, Loose Fit, and Class II, Medium Fit thread work, made to Tables III, IV and V.

Table XI contains the tolerances suggested for both standard and limit master thread gages for work designed in accordance with manufacturing tolerances for Class III, Close Fit thread work, made to Table VI. As the component tolerances for this class are relatively small, it is believed that the working gages will be required to be held within the gage tolerances shown in Table XI.

For plain plug gages, plain ring gages and plain snap gages required for measuring diameters of screw thread work, the gage tolerances specified in Tables VIII, IX, X and XI should be used. Attention is called to the fact that the tolerances on thread diameters vary in accordance with the number of threads per inch on the screw or nut being manufactured. In manufacturing a plain plug, ring or snap gage, in the absence of information as to the number of threads per inch of the screw to be made, or for gage dimensions other than thread diameters, the tolerances for plain gages given in Table VII may be used.

The tolerances on lead are specified as an allowable variation between any two threads not farther apart than the length of thread engagement as determined by the following formula:

$$L = (1.5)\ D$$

Where L = Length of thread engagement
D = Basic major diameter of thread.

TABLE XII. TOLERANCES AND LIMITS ON MAXIMUM AND MINIMUM MASTER, INSPECTION AND WORKING GAGES FOR SHAFT AND HOLE

Work to be gaged:			
Hole,	1.250 + 0.004	1.254	max.
	− 0.000	1.250	min.
Shaft,	1.248 + 0.000	1.248	max.
	− 0.004	1.244	min.

Gages for hole:

Maximum Gages

	Dimension of Part	Gage Tolerances	Gage Limits
Limit master gage	1.254	−0.0000	1.2540
		−0.0003	1.2537
Inspection gage	1.254	−0.0004	1.2536
		−0.0007	1.2533
Working gage	1.254	−0.0008	1.2532
		−0.0013	1.2527

Minimum Gages

Limit master gage	1.250	+0.0000	1.2500
		+0.0003	1.2503
Inspection gage	1.250	+0.0004	1.2504
		+0.0007	1.2507
Working gage	1.250	+0.0008	1.2508
		+0.0013	1.2513

Gages for shaft:

Maximum Gages

Limit master gage	1.248	−0.0000	1.2480
		−0.0003	1.2477
Inspection gage	1.248	−0.0004	1.2476
		−0.0007	1.2473
Working gage	1.248	−0.0008	1.2472
		−0.0013	1.2467

Minimum Gages

Limit master gage	1.244	+0.0000	1.2440
		+0.0003	1.2443
Inspection gage	1.244	+0.0004	1.2444
		+0.0007	1.2447
Working gage	1.244	+0.0008	1.2448
		+0.0013	1.2453

By comparison of the above figures, it will be seen that it is not possible for the master, inspection or working gage dimensions to overlap.

The tolerances on angle of thread as specified herein for the various pitches are tolerances on one-half of the included angle. This insures that the bisector of the included angle will be perpendicular to the axis of the thread within proper limits. The equivalent deviation from the true thread form caused by such irregularities as convex or concave sides of thread, rounded crests, or slight projections on the thread form, should not exceed the tolerances allowable on angle of thread.

The tolerances given for thread diameters in Tables VIII, IX, X and XI, are applied in such a manner that the tolerances permitted on the inspection and working gages occupy part of the extreme tolerance. This insures that all work passed by the gages will be within the tolerance limits specified on the part drawing as represented by the limit master gages. The tolerances given also permit the classification and selection of gages so that if a gage is not suitable for a master gage it may be classified and used as an inspection or working gage provided that the errors do not pass outside of the net tolerance limits. The application of the tolerances on diameters of thread gages is exactly the same as explained herein for plain gages. For an example of this application see Table XII.

TYPICAL SPECIFICATIONS FOR SCREW THREAD PRODUCTS

MATERIAL: The material used shall be cold-drawn bessemer steel automatic screw stock.

COMPOSITION:

Carbon, 0.08 to 0.16 per cent
Manganese, 0.50 to 0.80 per cent
Phosphorus, 0.09 to 0.13 per cent
Sulphur, 0.075 to 0.13 per cent.

METHOD OF MANUFACTURE: Bolts and nuts may be either rolled, milled, or machine cut, so long as they meet the specifications herein provided. Bolts and nuts to be left soft.

WORKMANSHIP: All bolts and nuts must be of good workmanship and free from all defects which may affect their serviceability.

FINISH: All bolts and nuts to be semi-finished; that is, the bodies to be machined, under side of head and nut faced, upper face of head and nut to be chamfered at an agle of 30 deg., leaving a circle equal in diameter to the width of the nut.

FORM OF THREAD: The form of thread shall be the "national form," as specified herein, and formerly known as the United States Standard or Sellers Thread.

THREAD SERIES: The pitches and diameters shall be as specified in Table I, herein, and known as the National Coarse Thread Series.

CLASS OF FIT: Class II-A, medium fit (regular).

DIMENSIONS: Nominal size: ½ inch. Number of threads per inch: 13. Length under head: 3 ±0.05 inches. Minimum length of usable thread: 1 inch. Diameters: (Specified in table XI of complete report.)

TOLERANCES AND ALLOWANCES: See Table IV.

NUTS: Form: Hexagonal. Thickness: ½ ±0.01 inch. Short diameter (across flats): ¾ ±0.01 inch.

HEADS: Form: Hexagonal. Thickness: 7/16 ±0.01 inch. Short diameter (across flats): ¾ ±0.01 inch.

GAGES: The gages used shall be such as to insure that the product falls within the tolerances as specified herein for Class II, Medium Fit (Regular).

The following gages are suggested and will be used by the purchaser:

For the Screw:

A maximum or "Go" ring thread gage.
A minimum or "Not Go" ring thread gage to check only the pitch diameter of the thread.
A maximum or "Go" plain ring to check the major diameter of the thread.
A minimum or "Not Go" snap gage to check the major diameter of the thread.

For the Nut:

A minimum "Go" thread plug gage.
A maximum or "Not Go" thread plug gage to check only the pitch diameter.
A "Go" plain plug gage to check the minor diameter.
A "Not Go" plain plug gage to check the minor diameter of the thread.

INSPECTION AND TEST: Screws and nuts shall be inspected and tested as follows:

At least three bolts and nuts shall be taken at random from each lot of 100, or fraction thereof, and carefully tested. If the errors in dimensions of the screws or nuts tested exceed the tolerance specified for this class; the lot represented by these samples shall be rejected.

DELIVERY: Unless otherwise specified the assembled bolts and nuts are to be delivered in substantial wooden containers, properly marked, and each containing 100 pounds.

The commission, in formulating this progress report, has acted largely in the capacity of a judiciary, basing its decisions upon evidence received from authorities on screw-thread subjects and upon the conclusions drawn by other organizations having to do with standardization of screw threads. In addition, the various subjects dealt with have been considered with a knowledge of present manufacturing conditions and with anticipation of further development in the production of screw-thread products. Above all, it is the intention of the commission to facilitate and promote progress in manufacture.

In the time provided the commission has devoted its attention to the standardization of only those threads, sizes, types and systems which are of paramount importance by reason of their extensive use and utility. There remains much to be accomplished along the lines of standardization of special but important threads, and of maintaining progress in our standardization work in keeping with the developments of manufacturing conditions.

The Hardening of Screw Gages With the Least Distortion in Pitch*

By Wilfrid J. Lineham†
Goldsmith's College, London

In the hardening of screw gages at Goldsmith's College it was required to find a means of quenching the steel after heating so that the distortion along the pitch line should be reduced to a minimum. The work was being done under the scheme inaugurated and supported by the London Council Education Department for war purposes.

I. Water Hardening

THE first law of hardening (known for many years) asserts that sudden quenching after heating retains the steel in the condition that prevailed at the quenching temperature.

The second law of hardening (of much more recent discovery) states that quenching, while crossing an arrest or recalescence point, produces the least amount of distortion, and it is one of the purposes of this paper to endeavor to prove the truth of this law. A second reason for the paper is to offer the author's results to other screw-gage manufacturers for their immediate assistance.

The second law had already been used by other investigators and practically applied with material success, but the author was unaware of the exact researches that have led to the adoption of fixed temperatures. The Wild-Barfield process he believed to be the first practical example, the principle of which is to use the change in magnetic properties of wrought iron or steel when passing from the β to the α state to indicate the temperature at which to quench. Reference to the Roberts-Austen diagram, Fig. 1, shows this to occur along the Ar2 line, temperature 765 to 770 deg. C. (1,409 to 1,418 deg. F.).

The Horstmann Brothers arrived at a similar result by quenching at 700 deg. C. (1,292 deg. F.), which is the temperature of the eutectoidal line Ar1. The screw gages they manufactured were produced, they said, with no alteration in pitch, but a slight swelling always occurred in diameter, which was lapped down afterward. They kindly communicated their method to the author, who thereupon decided to make his own investigations, the results of which are now set forth.

The author's first-sought ideal was a quenching temperature which would produce no distortion whatever, but it will be seen that this has not been achieved, nor does it seem likely that anything more than a minimum distortion can be arrived at. The Ar1 line for the use of the second law appeared to have manifest advantages over that at Ar2 because of its constancy of temperature over a large range of carbon percentages; and it seems reasonable to expect that steels of any carbon content will act in the same manner when cooling across this line, if all are free from impurities.

Before the war the manufacture of screw gages was confined to the use of high-carbon steel, say, from 0.85 to 1.2 per cent carbon, which was usually left unhardened, on account of the difficulties caused by distortion on quenching. The making of hardened screw gages had been practiced to a very limited extent before 1914, the correction after hardening being obtained by the use of laps of cast-iron or boxwood. The method taken generally has now been revived and extended, and is the only one followed at the present time, so a short description will be useful in order that the author's intentions may be understood.

Assuming that the gage can be hardened with so little change that the pitch tolerance, plus or minus, is not exceeded, which it will be shown can be done, the process of making a gage involves, first, the accurate screwing of the blank, and then hardening the screwed piece.

The first was carried out in a lathe accurately corrected in pitch by a cam bar. The screwing tool, known as a form tool, was of disk shape and supplied with chasing teeth on its circumference. Two of these "form chasers" were used, both being quite accurate in pitch and of perfect sectional contour for the thread to be cut. One was used to rough out the gage screw to about half or two-thirds the thread depth; and the

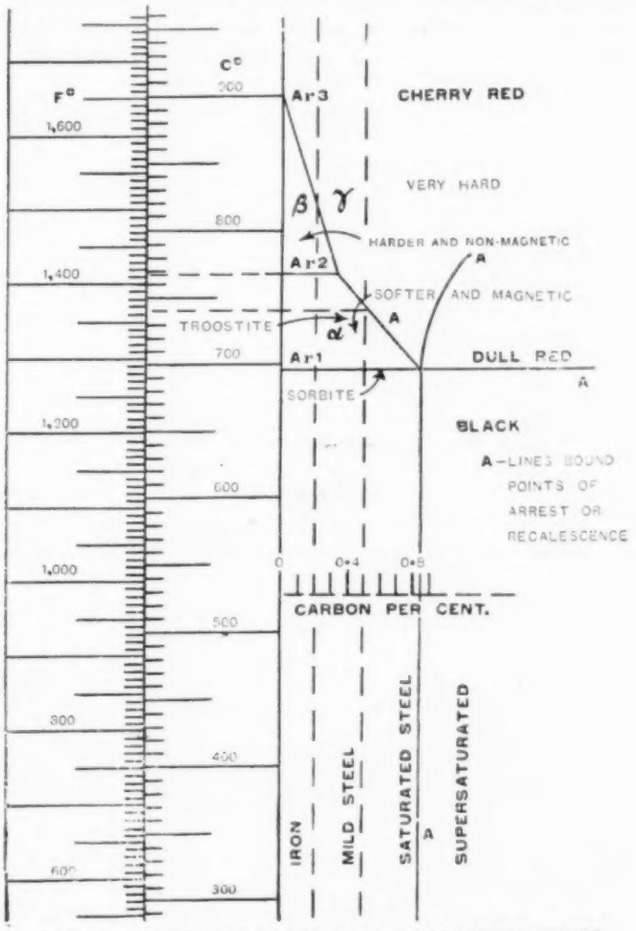


FIG. 1. PORTION OF THE IRON-CARBON DIAGRAM

*Read at a meeting of the Institution of Mechanical Engineers.
†Deceased.

other, very carefully adjusted in position, to finish the thread correct on core, crest and effective diameters and full form. Constant measurement was, of course, necessary, but as the lathe slides were provided with micrometer disks, rapid and almost automatic manufacture was soon secured. The intention of the author at

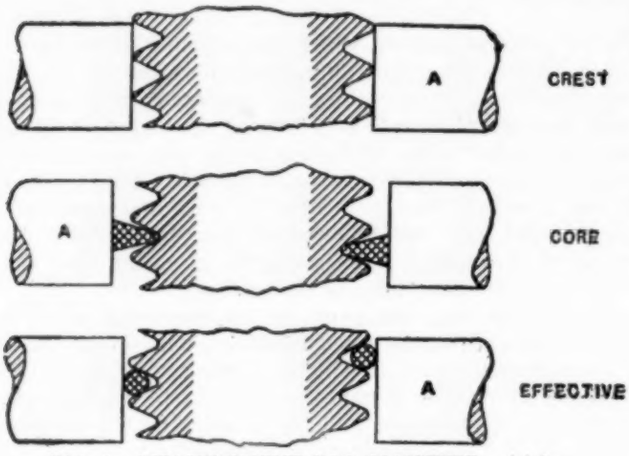


FIG. 2. MEASUREMENT FOR DIAMETER. AAA—MICROMETER-ANVILS

this stage of the work was to just clean up the gage with a full-form cast-iron lap, accurately made from a tap cut in the before-mentioned lathe. This method of lapping proved a failure, the abrasive clinging to the soft gage and causing "scoring," so he fell back on the cutting tool itself for the accuracy demanded, assisted by the use of a very mild steel of 0.14 per cent carbon for the blanks that cut with a polish. The object of the screwing operation was to produce a gage that was *perfect* in all dimensions while yet in the *soft* state.

The next step was to harden. The hardening of screw gages, and, indeed, some others, was performed in a cyanide furnace, made by John Wright, of Birmingham, which consisted of a rectangular cast-iron bath, covered and ventilated to remove the fumes, filled with sodium cyanide, and heated by coal gas and air, the latter being fed at a pressure of 3 lb. per square inch. The cyanide, which melted at about 600 deg. C. (1,112 deg. F.) and boiled at or near 800 deg. C. (1,472 deg. F.), was maintained at 750 to 770 deg. C. (1,382 to 1,418 deg. F.) when in use, the temperature being indicated by a thermo-couple pyrometer. The gages (of mild steel) were placed on trays suspended clear of the bottom of the bath and soaked from ten minutes to one hour, according to size, or until they had acquired the requisite depth of case.

The Cyanide Bath

If a greater depth of case than 0.005 in. be required, packing the gages with barium carbonate and bone black in closed boxes and soaking in a muffle furnace at about 850 deg. C. (1,562 deg. F.) must be resorted to, but the final heating should be completed in the cyanide bath.

It is possible to allow the cyanide bath to cool to the quenching temperature (supposing that to be exactly known) after the requisite soaking of the gage, but the process absorbs much time and increases expense, and is not to be advised for continuous working. Also the temperature may be ascertained by the color of the gage, which may be taken as a very dull red, but this is not advisable. The author therefore installed, in addition to the cyanide bath, a Brayshaw salt-bath furnace, using "pyromelt," and kept that fur-

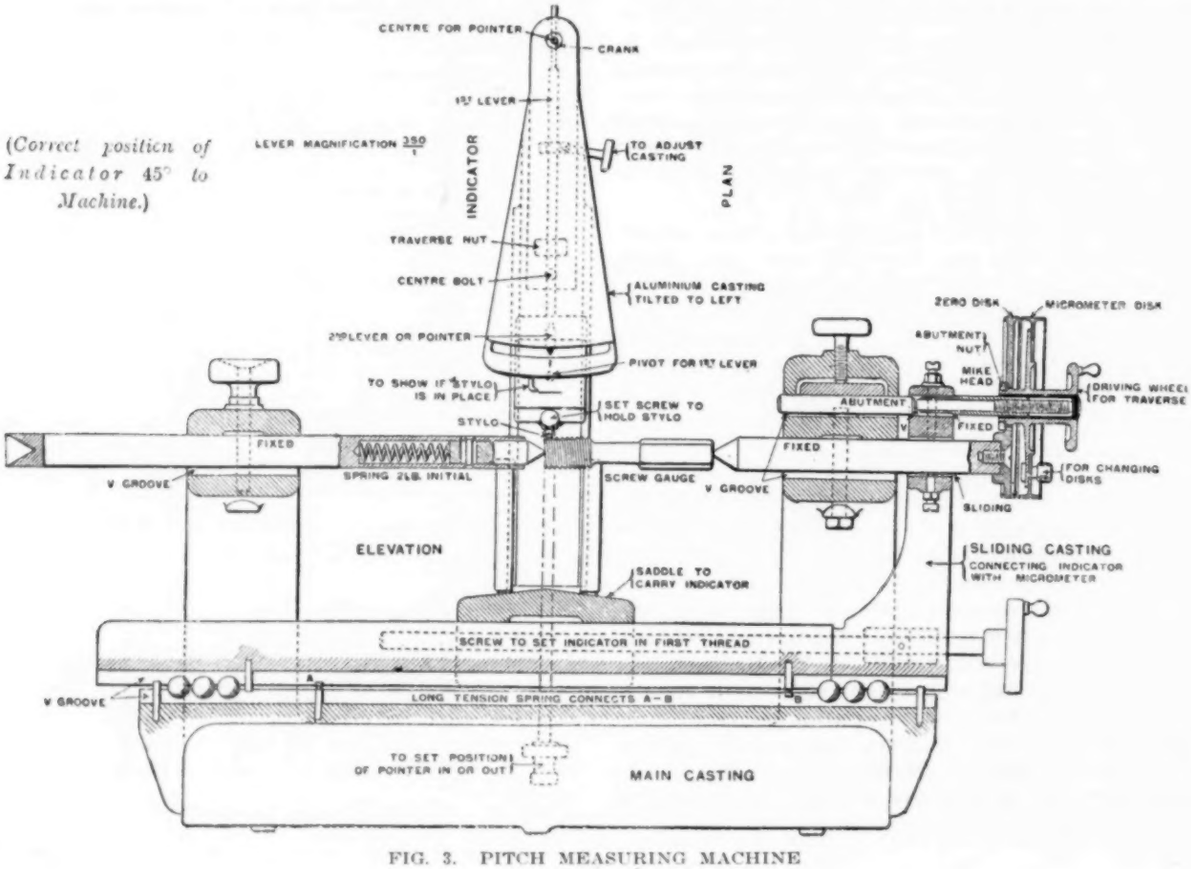


FIG. 3. PITCH MEASURING MACHINE

nace at the constant quenching temperature. This furnace was called the "store furnace," for when a gage had had its full time in the cyanide it was stored here at quenching temperature until its heat had evened up; and it was afterward quenched at leisure. The quenching tank was close to the store furnace and of ample capacity, with inflow and outflow cocks.

The screw gage was next measured for pitch and diameters. The diameter measuring machine has already been illustrated in the *Proceedings*, 1917, page 54, and Fig. 4, page 55, and the mode of its use is merely suggested in Fig. 2 (page 5), which shows the micrometer anvils at the moment of measurement.

The Pitch-Measuring Machine

The pitch-measuring machine, Fig. 3, was designed by the National Physical Laboratory and constructed at Goldsmith's College. The drawing is somewhat diagrammatic in order to show the principle clearly. The gage is supported between centers on the main or fixed casting. A movable carriage supports an indicator on the left and a micrometer on the right, being always pressed leftward by means of a weight. The indicator carries a stylo, which engages with the screw thread, and a pointer in connection therewith, whose reading is multiplied so as to be in the region of one-millionth of an inch of sensitiveness. The micrometer abuts

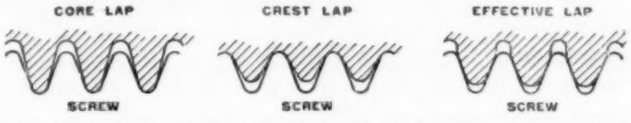


FIG. 4. LAPPING THE SEPARATE ELEMENTS OF A SCREW

against the main casting and can be read to 0.00001 of an inch, and very rapid charting of screw errors can be obtained.

After hardening, it was found that the screw pitch had not distorted beyond the tolerance, plus or minus, if precautions had been taken such as suggested later. The diameters, however, had increased, at least the core and crest were larger, but the effective surface was often unchanged. The operation of lapping followed, three laps, Fig. 4, being used; but the enlargement being only about 0.0001 to 0.0003 in. in diameter, the amount of lapping was very little. Naturally the operation was of a delicate character, and was the particular part of the whole process that most held up delivery; many gages were spoiled in its exercise; but it is believed that the whole hardening process will yet be so perfected that only a full-form cleaning lap will be necessary.

Gages Examined by Optical Lanterns

Finally each gage was examined by an optical lantern magnification of exactly fifty to one, as already described in previous papers; and of course the pitch and the diameters at all three elements of section were thoroughly tested during the stages of manufacture and just before delivery, by a competent staff of examiners. It will be said that if only a screw gage could be made to travel through its various manufacturing steps in such a simple and well-oiled manner, the difficulties of screw gage making would be completely overcome. It is one intention of this paper to show that the difficulties of manufacture are being overcome by the adoption of definite scientific method, and there are strong and practically certain hopes of doing away with lapping altogether.

The crucial point of the manufacture is the hardening. Lathes have been specially built that will produce accurate pitch, and mild steel is being used that can be finished in those lathes with a polish. It will be shown

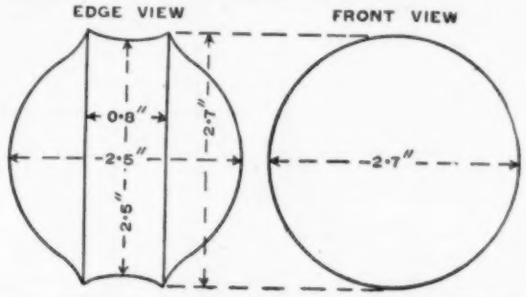


FIG. 5. A DISK OF MILD STEEL 4¼ IN. IN DIAMETER AND 1½ IN. THICK ORIGINALLY, WAS SWOLLEN AS SHOWN BY MEANS OF 1,000 SUCCESSIVE HEATINGS AND QUENCHINGS. ORIGINAL VOLUME 21.28 CU.IN. FINAL VOLUME 21.60 CU.IN.

that a quenching temperature can be found that only lengthens the pitch by 0.0002 in. over 0.7 in. of length, which is within the pitch tolerance, 0.0003 in., on such a length for inspection gages of correct effective diameter.

Two remarkable examples of distortion are shown. The first, Fig. 5, was, before treatment, a cheese-shaped disk of 4¼ in. diameter by 1½ in. thickness, of common mild steel. It was heated in a coke fire and quenched in water, the operation being repeated about a thousand times. The continued distortion has swelled the disk into an approximate spherical form, but that the volume is unchanged was ascertained by displacement measurement.

The second specimen, Fig. 6, was at first a rectangular disk, and here again the spherical form is attempted, the treatment being the same as in the first example.

These two specimens came to the author as a piece of exceptional good fortune, being presented by F. A. Thompson. Their history is: A garage boy required buckets of hot water at meal times and kept three of

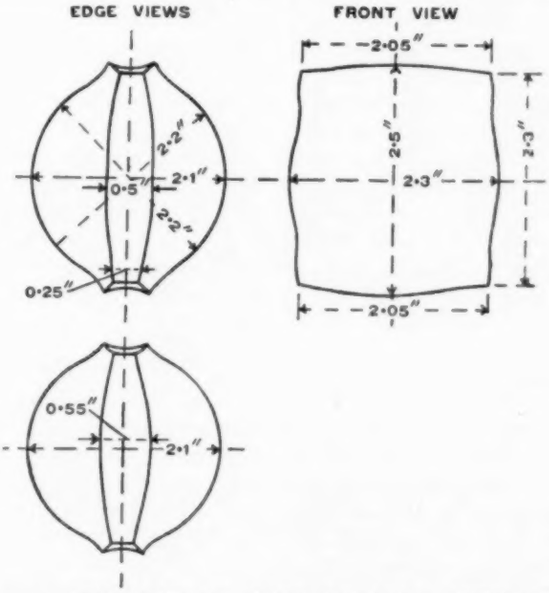
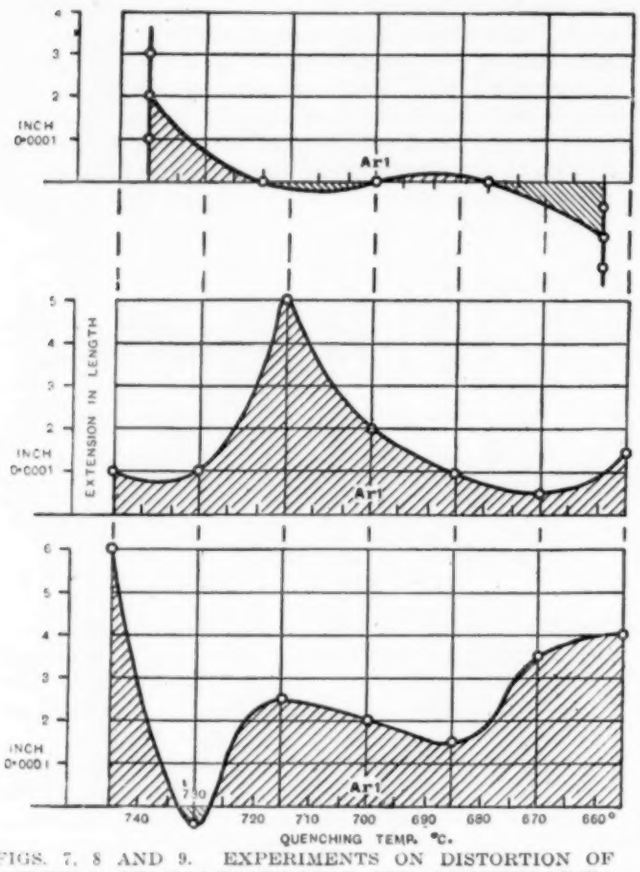


FIG. 6. RECTANGULAR DISK OF MILD STEEL WAS SWOLLEN AS SHOWN BY MEANS OF 1,000 SUCCESSIVE HEATINGS AND QUENCHINGS



FIGS. 7, 8 AND 9. EXPERIMENTS ON DISTORTION OF SCREW GAGES IN LENGTH ONLY: VIZ.: ON PITCH LINE. J AND L MILD STEEL 0.14 PER CENT CARBON. CASED IN SODIUM CYANIDE FOR 30 MIN. AT 750 DEG. C. SPECIMENS $\frac{5}{16}$ IN. IN DIAMETER BY 0.7 IN. LONG

Fig. 7—Average change of length (measured over the end surfaces). Fig. 8 — Distortions all extensions. Fig. 9 — Curve which seemed to indicate no fixed law.

these pieces hot on coke fires, using which he pleased to heat the water by immersion, and continuing his unintentional experiments over a period of about a year.

The author commenced his experiments in April, 1918, by providing seven specimens for each experiment, the material being J and L steel of 0.14 per cent carbon. Each specimen was ground and carefully surfaced by stoning the ends, and the dimensions were about $\frac{5}{16}$ in. in diameter by 0.7 in. long. Previous experiments upon pieces of full gage shape showed the wisdom of using simple cylinders for the temperature tests so as to obtain symmetrical distortions.

One form of distortion resulting from hardening a cylindrical piece of steel was found to be a swelling or bulging at the ends, but the length, measured at the edges, remained very little changed indeed.

The experiments were begun without any clear notion of the form the distortions were likely to assume, and axial measurements were at first made, which proved to be wrong for the purpose required. Also the ends of the cylinders were not parallel to less than 0.0001 in., and the average dimension was taken in the hard and in the soft states respectively. When, however, the circumference was divided into three or four parts and marked, and the change of length taken at the marked positions only and afterward averaged, quite consistent results were obtained, the figures fairly representing pitch line distortions on a screw gage.

Figs. 7 to 12 show, for six sets of experiments, changes of length in units of 0.0001 in. plotted on a base of quenching temperature.

Fig. 7 (April 5, 1918) is a record of the average change of length measured over the end surfaces, and contains the axial bulging. It was on this set that the bulge was first noticed, and from this time onward measurements were made on the edges only. The temperature of 700 deg. C. (1,292 deg. F.), however, is indicated as that of no distortion.

Fig. 8 (April 24, 1918). The distortions are all extensions, and 670 deg. C. (1,238 deg. F.) indicates least distortion. Several screws were hardened at this figure with success.

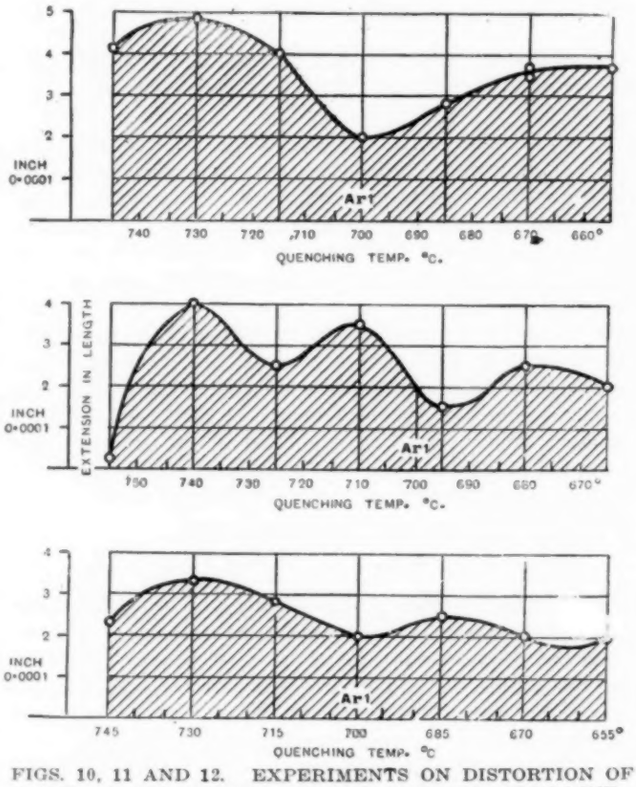
Fig. 9 (April 27, 1918). This curve was distressing. It seemed to show that there was no fixed law and that nothing would result from the labor. The figure 685 deg. C. (1,265 deg. F.) was taken as best, for the drop at 730 deg. C. (1,346 deg. F.) might not be trustworthy.

Fig. 10 (May 4, 1918). A good curve showing 700 deg. C. (1,292 deg. F.) to be decidedly the best temperature. Two specimens were quenched at 670 deg. C. (1,238 deg. F.) and are shown to fairly agree.

Fig. 11 (May 9, 1918). Another wavy curve, with minimum at 695 deg. C. (1,283 deg. F.).

Fig. 12 (May 11, 1918). There is here a minimum at 700 deg. C. (1,292 deg. F.), but also at three other temperatures.

The problem, which now appeared hopeless, suddenly cleared itself. It occurred to the author to plot all the curves on one sheet by superposition, as in Fig. 13, and this operation was at once fruitful in showing that



FIGS. 10, 11 AND 12. EXPERIMENTS ON DISTORTION OF SCREW GAGES IN LENGTH ONLY: VIZ.: ON PITCH LINE. J AND L MILD STEEL 0.14 PER CENT CARBON. CASED IN SODIUM CYANIDE FOR 30 MIN. AT 750 DEG. C. SPECIMENS $\frac{5}{16}$ IN. IN DIAMETER BY 0.7 IN. LONG

Fig. 10.—Curve which indicates that 700 deg. C. (1,292 deg. F.) is the best hardening temperature. Fig. 11—Wavy curve with minimum at 795 deg. C. (1,283 deg. F.). Fig. 12—Minimum at 700 deg. C., but also at three other temperatures

the distortion, or, as it may now be called, *extension*, had definite laws and was not the result of mere chance. Disregarding the first curve shown dotted, all cross at exactly one point, namely, 700 deg. C. (1,292 deg. F.), the recalescent point Ar1 of the equilibrium diagram. The extension is, unfortunately, not obliterated, but it has a fixed and definite value of 0.0002 in., and is within the tolerance limits. It indicates a condition of stability, and if 700 deg. C. (1,292 deg. F.) be made the quenching temperature, this extension can be allowed for when cutting the screw.

Other parts of the curves show nothing but instability. The use of the position 700 deg. C. (1,292 deg. F.) therefore is calculated to assist correct manufacture, while all the other temperatures are unreliable. On that account, an attempt to find a stable temperature of maximum extension, for use when needed, was practically unsuccessful; for gages quenched at 715 deg. C. (1,319 deg. F.) did not always extend well. A very important point is that the temperature must be found with accuracy, the range of stability being so very limited.

In Fig. 14 the distortion scale has been magnified and plotted for a range of 15 deg. ± of 700 deg. C. Maximum instability occurs at 715 deg. C. as well as maximum distortion, and in all cases temperatures below 700 deg. C. are safer than those above. A fair and safe latitude for quenching lies between 690 deg. C. (1,274 deg. F.) and 700 deg. C. (1,292 deg. F.).

The author found no difficulty in making sure of 700 deg. C. with the use of a platinum-rhodium thermocouple, a thermometer within the galvanometer-case giving warning of any change of temperature of the cold junction. Upon retesting the thermocouple after about six months' use it was found by the makers to be quite accurate.

It now appears that the second law of hardening proposed at the commencement of this paper is proved so far as the line at Ar1 is concerned, and could no doubt be proved for other arrest points.

In the early stages of this research measurements of distortion on diameter were made, which always showed an increase of about 0.0001 to 0.0003 in., but the purposes of the research being the measurement of length distortion in screw gages, and time being pressing, diameter measurements were not proceeded with.

Before obtaining the pyrometers, which were not in use before April 5, some experiments were made on a color scale extending through

Bright red
Gray just appearing (due to freezing of the cyanide)
Full gray
Dull red
Black just appearing
Mid black
Full black

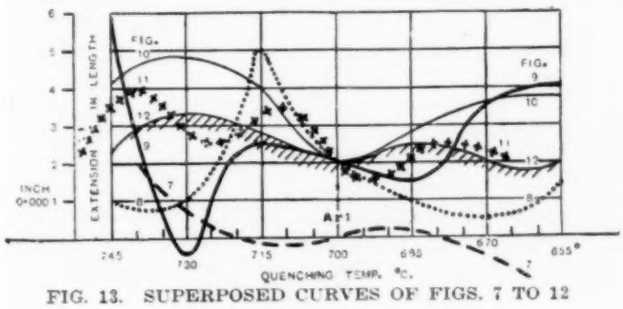


FIG. 13. SUPERPOSED CURVES OF FIGS. 7 TO 12

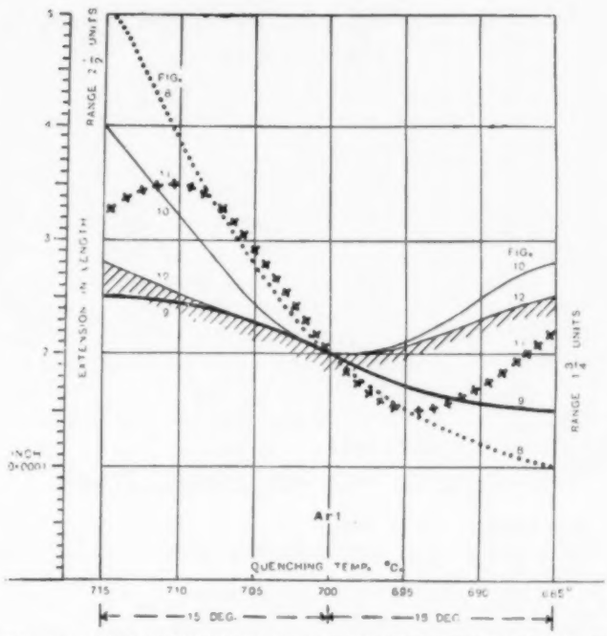


FIG. 14. ENLARGEMENT OF THE DISTORTION SCALE TO 15 DEG. ABOVE OR BELOW Ar1

—the specimen being held in a half light. The results pointed to a best temperature between dull red and black just appearing. Some experimenters have further perfected the color test, but the author considered the pyrometer method undoubtedly superior, and with his system of two furnaces could be practiced by a somewhat unskilled operator.

Further experiments are needed on ring gages, which have laws of their own as regards diametric distortion, and the author had hoped to make experiments on other gage shapes.

It has not been exactly discovered what the first stages of distortion assume, for in the boy's experiments the diameters are all decreased, though it is certain they increased at first. It was believed that a barrel shape was first produced, coupled with end swelling, but careful test has shown a festoon shape on the rim, and it must be always remembered that Nature insists on keeping the volume constant.

Instead, however, of waiting till all these facts could be obtained, it appeared wiser to make known the results that had already been acquired, in order that screw gages might be produced more easily and accurately by every manufacturer in a time of need.

The fact of the emulsive constitution of steel at Ar1 led the author to believe that gages quenched on this line would not be thoroughly hard. He was glad to say that, on the contrary, he had found them in every case to be glass hard. It must not be forgotten that the process of hardening by casing in cyanide produces a high-carbon steel at the surface, while the interior remains in the mild state, and this may have something to do with it.

The most important of the conclusions arrived at in this paper are:

(*a*) The second law of hardening is proved.

(*b*) A temperature of minimum distortion that can be relied upon is 700 deg. C. (1,292 deg. F.).

(*c*) No variation is allowable *above* 700 deg. C.

(*d*) An allowance of 10 deg. below 700 deg. C. is practically permissible.

Frivolous Stuff in the Plant Paper

By Frank H. Williams

Once upon a time, when I was editing an internal house organ or plant paper as we called it, the manager of the corporation said:

"Now, don't put any frivolous stuff in the paper. Put in all the inspirational, uplift stuff you want, but cut out all slang and all frivolous material. We're paying a lot of money to get this paper out and we've got to make it boost our business, not a sort of funny paper for our employees. I want it to be a constant source of inspiration and uplift for the people who work for us. Don't forget this when you're editing it."

At first, hearing that sounded like a very fine and commendable attitude to assume toward the plant paper, but how did it work out?

How the Manager's Ideas Worked Out

It worked out like this:

We spent a lot of money for fine paper and we spent a lot of money for cuts and we spent an infinite amount of time and thought in making the paper everything that the manager wanted it to be, and as the result of this expense and effort *the employees simply wouldn't read it!*

All of which is very pertinent to a discussion of "frivolous stuff" in the plant paper. Will employees read such a publication unless there is a certain amount of "jazz" or kidding in it? Will they pay much attention to a publication which does nothing but preach and nag and suggest improvements, all in a deadly, dull, heavy manner?

As long as employees are human it does seem as though the human-interest stuff has the most chance of registering with them. It does seem as though no regular folks will ever take very avidly to the perusal of preachments from those "higher up." And, for this reason, it does seem as though a certain amount of lively material is essential to the success of a plant paper.

But what form shall this liveliness take? How shall it be injected into the plant paper so as to liven the sheet up without letting it degenerate wholly into a funny sheet?

How to Use "Jazz" in a Plant Paper

Plant paper editors solve this problem in various ways, their solutions frequently being governed almost entirely by local conditions. But whatever the local conditions are it is always interesting to note what is being done along this line by the editors of other successful internal house organs. For this reason we should find it interesting to consider the question of "frivolous stuff" in the *Bowser Booster*, a very successful plant paper issued by S. F. Bowser & Co., Inc., of Fort Wayne, Indiana.

At the first inspection of this publication it is seen that there is always present a sprightliness and a good nature about the way things are written up which tend to make the items readable because of the way in which they are written and not alone for the things that are said. For instance, in a department headed "Who's Who in Bowserdom" appear sprightly items about the employees of the works written in such snappy, invigorating style as this:

"This, ladies and gentlemen, is the right honorable Homer Irven, Foreman of the Light Tank Shop. Under his direction are built flocks of type B, C, D and E tanks. And after finishing his day's task with so much of the alphabet he hies him home and looks after guinea pigs galore and thoroughbred rabbits. As a tank-builder he's right there—having had some twelve years' Bowser experience, and when not making tanks his delight is to make eight rabbits grow where one grew before."

Such a write-up is certainly a lot more interesting than the usual dry-as-dust "Who's Who" biographical sketch. And when accompanied by a thumb-nail photo, as each biography in this department is, the writeup is interesting to people outside the plant as well as those in the factory. And when a plant paper is written so entertainingly as to interest folks outside the plant as well as the employees, then it is certainly functioning at pretty close to 100 per cent. But such a write-up as this can hardly be called "frivolous stuff." It is written with a light touch, of course, but it is not exactly frivolous.

A Little Nonsense Now and Then Relished

A little nonsense now and then is relished by the most serious of employees. And if this nonsense or frivolity comes to them through the plant paper it is inclined to make them feel that the plant is a lively human, interesting entertaining place in which to work. It is inclined to make them feel that there's a lot of life and good spirits about the bosses even if they are rather somber-faced and always anxious for a greater production.

Frivolity is a great thing for the dissipation of the fumes of wrong thinking and of "bad" acting. It is a great thing for getting employees into a comfortable frame of mind. And for that reason, if for no other, it has a very definite reason for its existence in plant papers.

This thing of everlastingly preaching at employees by means of house organs, bulletins and plant meetings is enough to get the goat of any employee who feels that he is doing all that he's got in him and who has the normal human's healthy dislike for too much "goody-goody" stuff. Uplift and inspiration are all right in their way but the very fact that employees consistently avoid plant papers which harp too heavily on these topics should be an indication that such topics are in mighty bad order when they are given too much prominence.

Too Much Frivolity Better Than Not Enough

Of course, as has been indicated in the preceding, there is a chance of getting too much frivolity into the plant paper. That, of course, is a mighty bad thing. But isn't it a lot better to have too much frivolity and have the employees up and shouting for the regular appearance of the plant paper than it is to have too little frivolity and to watch the papers dropped carelessly from their hands within an appreciable number of seconds after receiving the copies?

Get frivolous once in a while in the plant paper and watch how quickly the employees respond by showing an increased interest in the publication.

Forget the uplift stuff for a while and be human and humorous and entertaining.

Give the employees the sort of stuff they want to read.

That, in the final analysis, is what makes or breaks a plant paper. If it contains the sort of stuff the employees like to read, then it will be a success. If it doesn't contain such stuff—*GOOD NIGHT!*

Machining Front Axles

By FRED H. COLVIN
Editor, *American Machinist*

THE first operation is to inspect the forgings for straightness and to correct any inequality. This is done in the fixture shown in Fig. 1. Here the two substantial blocks *A* and *B* are mounted on the massive plate *C*, and are so designed that no stresses which may be imposed in straightening the forgings will materially affect their alignment. The front axle is laid in the position shown and held by the wedges *D* and *E*, which are quickly handled and at the same time hold the axle firmly in place. Then the gages *F* and *G* are applied and if straightening is necessary, it can be easily and quickly accomplished by using the bar *H*. After straightening, the first operation is milling the ends in the very interesting fixture shown in Fig. 2. Here the axle *A* is laid on its side, the end being supported by block *B* and *C* and clamped firmly in place by the toggles operated by the screw *D* and handwheel *E*. This fixture has compensating connections so as to equalize the pressure to make up for inequalities in the forging. Gangs of inserted tooth cutters are used on each end of the axle, there being four cutters in each gang. The cutters are substantially supported and gear driven, allowing the eight surfaces to be finished at one cut. Spindles *F* and *G* are designed to carry milling cutters for facing the spring pads when this is considered desirable. Next comes the drilling of the spindle holes, the novelty here being the use of spring pressure for holding the work, which allows rapid manipulation in clamping the forging firmly in position during

Without going into extreme details concerning the manufacture of front axles, there is shown herein some of the principal operations applied by the Columbia Axle Co., Cleveland, Ohio. The illustrations suggest methods which cannot fail to be helpful in any similar work.

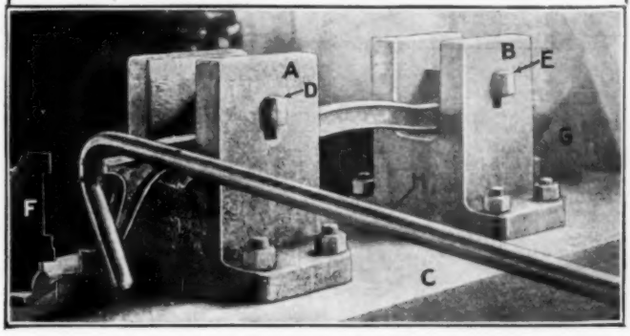


FIG. 1. STRAIGHTENING THE FORGINGS

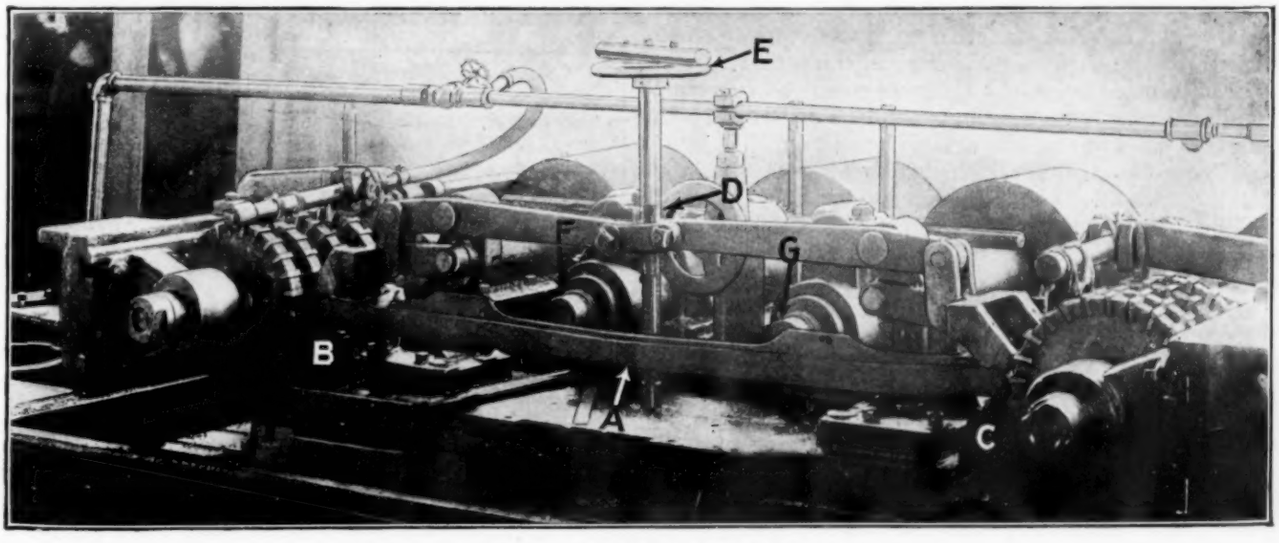


FIG. 2. MILLING BOTH ENDS

AUTOMOTIVE CONSTRUCTION

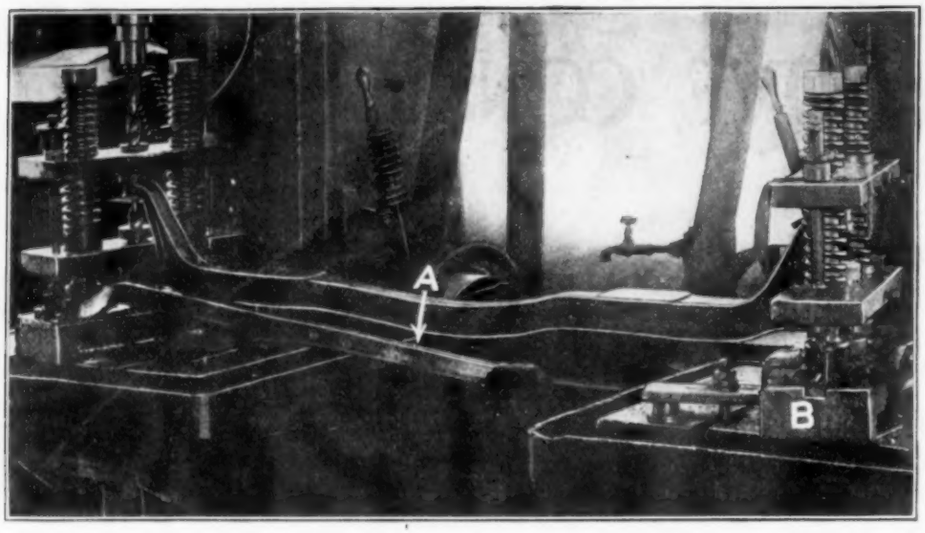


FIG. 3. DRILLING THE SPINDLE HOLES

the drilling operation. The lower ears of the axle fit into suitable guides beneath the lower bushing plate and by the lever *A*, Fig. 3, both bushing plates are raised so as to allow the easy insertion of the work. By strapping the right-hand fixture *B* to the table of the machine and allowing the other drilling fixture to move slightly on the table of its machine, compensation can be readily made for slight inequalities in the forgings. The heavy compression springs hold the drilling fixture firmly in place during the drilling operation.

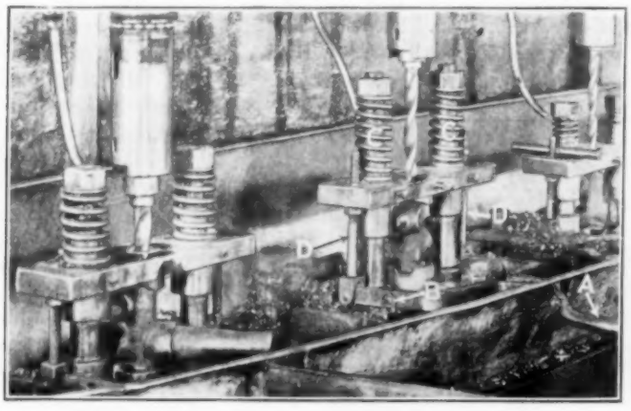


FIG. 4. DRILLING THE STEERING KNUCKLES

Leaving the axle for a moment and taking up the steering knuckle, Fig. 4, we find the same type of drilling fixture as shown in Fig. 3. This illustration makes the operation more understandable as it can readily be seen that the lever *A*, with its forked ends fulcrumed in *B*, enables the operator to compress the springs *C* by means of the rods *D* which impart the upward motion of the forked ends of the lever to the plate carrying the drill bushings. Centering cups are provided for each end of the spindle portion of the steering knuckles so that it is only necessary to raise the bushing plates by means of the lever *A*, insert the knuckle, release the lever and begin drilling at once. On a hole of this length a single operator easily handles four spindles. The side hole for the steering arm is drilled and reamed in the simple fixture shown in Fig. 5. The mandrel *A* slips through the hole which has been previously drilled for the spindle and rests in a pair of V-blocks which form part of the fixture *B*. The end which forms the stub axle rests on the wedge *C* while the strap *D* holds the knuckle firmly in place while it is being drilled and taper-reamed. The main steering arm is an awkward piece to machine on account of its irregular shape, as can be seen in Fig. 6. Fig. 7 shows the methods of drilling both ends in the same kind of drilling fixtures. The arm *A*, Fig. 6, is held in the jaws *A* and *B* in the drilling fixture shown in Fig. 7, the jaws being operated by a right- and left-hand screw, controlled by the hand-wheel *C*. The jaws center the boss *A*, Fig. 6, and the hole is drilled and reamed in the usual way by the

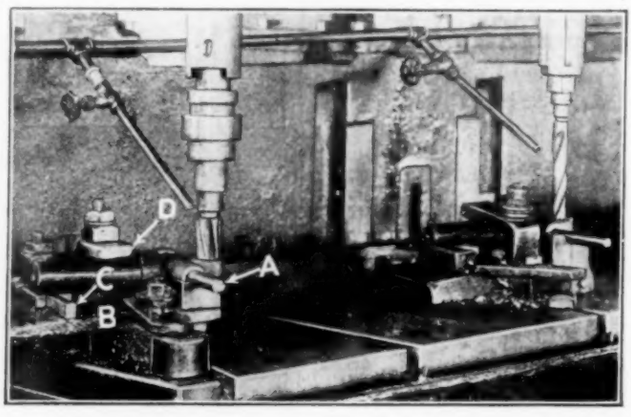


FIG. 5. DRILLING AND REAMING FOR STEERING ARMS

FIG. 6. THE MAIN STEERING ARM

AUTOMOTIVE CONSTRUCTION

aid of suitable bushings. The hole in the boss *B* is drilled in a similar fixture shown at the right in Fig. 7, the same kind of jaws holding the other end with equal facility. The final drilling of the axle, Fig. 8, takes place after the steering buckle and the connecting bar are in place. The axle is held in the jaws *A* and *B* which are operated by the handwheels shown. The stub axles slip in the slides *C* and *D* and the drill bushings are located in the plates *E* and *F*, which are connected by the rods shown, and swing

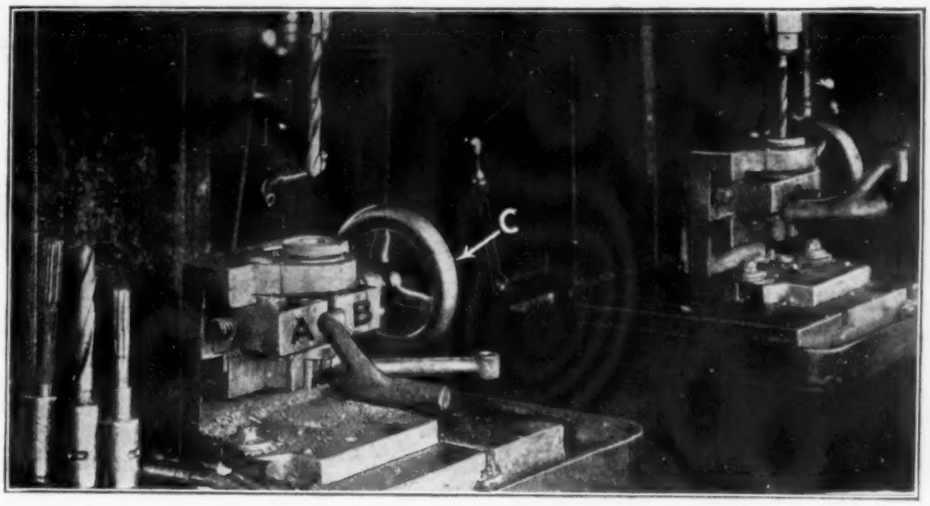


FIG. 7. DRILLING THE MAIN ARM

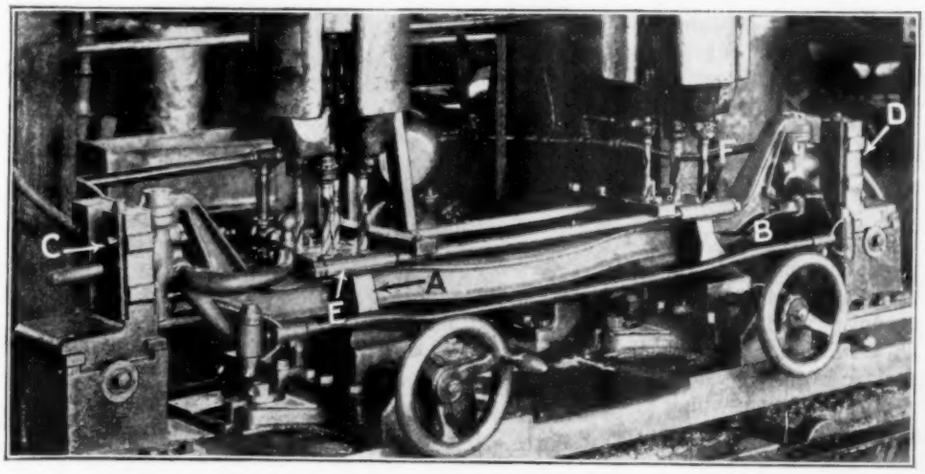


FIG. 8. DRILLING SPRING PADS ON COMPLETED AXLE

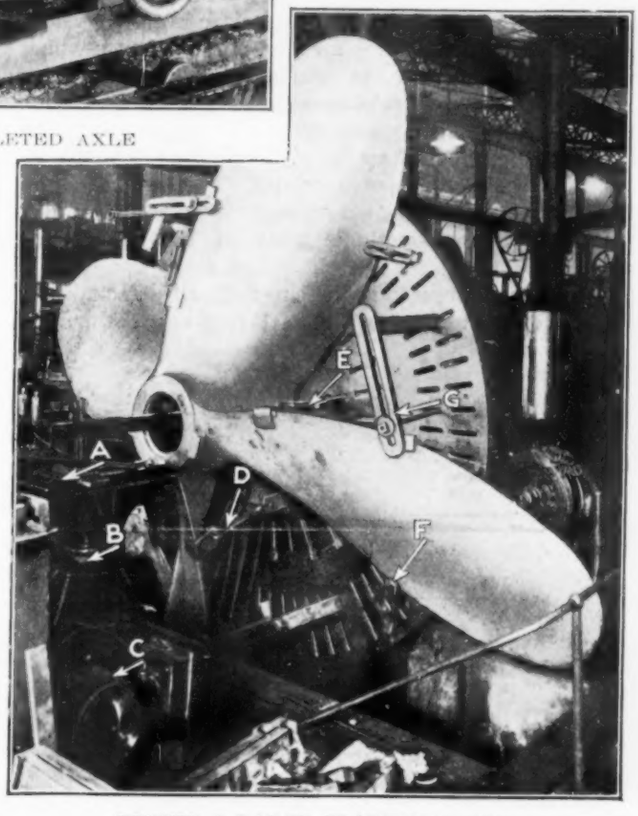
over the axle from the rear. The eight holes are drilled at once, four drills being driven by each spindle. This fixture centers the location of the springs and through them, the whole chassis, from the stub axles, so as to avoid the car body being out of center.

Boring an 11-ton Propeller

The boring of a large propeller is an awkward job, and requires considerable care and ingenuity in handling, as well as in machining. The propeller shown in the illustration is a solid bronze casting 18 ft. in diameter, weighing 22,420 lb. and is in the shop of the Union Plant of the Bethlehem Shipbuilding Corporation. This plant was formerly known as the Union Iron Works, and built the battleship "Oregon".

It is rather unusual practice for a propeller of this size to be cast in one piece, and it is doubtful whether any other plant on the Pacific Coast could have handled this job without special machinery being set up or built. The Union Plant cast and bored this propeller for the Moore Shipbuilding Co., which was doing the repair work on the S. S. "Howick Hall."

It will be noted that the boring tool is carried in the slide *A*, mounted on the swiveling stand *B*, and that the feed is provided by the small motor *C* through the proper gearing. The swiveling base allows the tool slide to be swung at the proper angle, so as to secure the desired taper for the hub fit on the tail shaft. The combination hooks and turnbuckles at *D* and *E*, together with the clamps *F* and *G*, hold the work firmly in place.



BORING A LARGE PROPELLER HUB

An Indicating Attachment for Locating and Boring Holes on the Milling Machine

By R. H. Kasper

When locating and boring holes in work on the milling machine, by use of an indicator and locating buttons, it is inconvenient to take a reading of the dial during a complete revolution of the indicator. It is sometimes impossible to see the dial even with the aid of mirrors.

To overcome this difficulty, the attachment shown in the sketch was designed. By the use of this attachment, the indicator remains stationary and therefore the dial is always in plain view of the operator. Fig. 1 shows a general view of the attachment and the method of using. It will be noted that the attachment is composed of two parts, which are dove-tailed together so as to produce a sliding fit with a minimum of lost motion. The outer part (Fig. 2) is carefully ground on the outside and carries a round-pointed screw which comes in contact with the locating button. The screw is located on the same diameter as the dove-tail. A coil spring holds the screw always in contact with the button. The shank may be cylindrical or tapered, to fit either the spindle or the chuck. Fig. 3 shows the shank which is dove-tailed to carry the outer portion. Fig. 4 is a cross-sectional view of the attachment assembled.

The contact screw must be carefully adjusted to suit the size of button being used. After once being set, the screw needs no further attention, until a different diameter of button is to be used. Adjustment of the screw is easily made. From the outside diameter of the attachment, subtract the diameter of the button and divide the remainder by two. The result obtained should be the dimension *A* in Fig. 4.

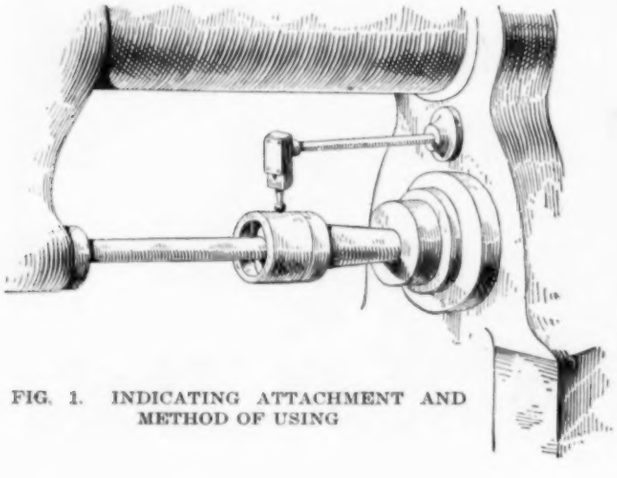
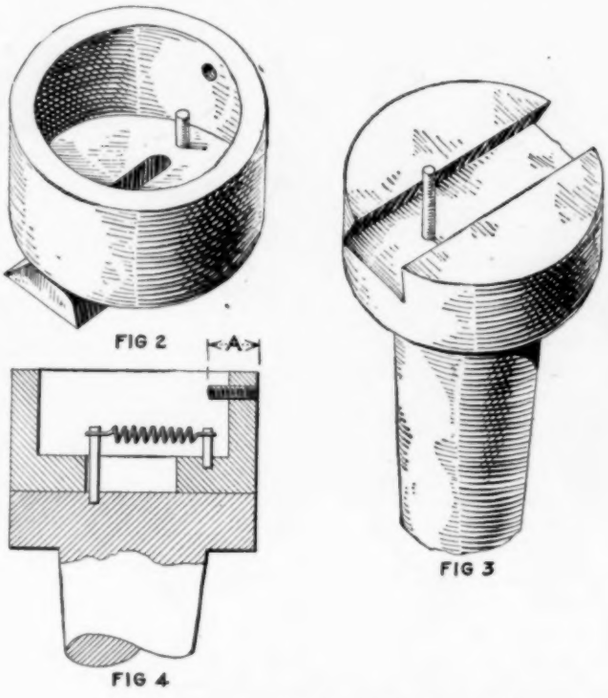


FIG. 1. INDICATING ATTACHMENT AND METHOD OF USING



FIGS. 2 TO 4. PARTS OF ATTACHMENT AND CROSS-SECTION

Fig. 2—Outer part of attachment which carries contact screw. Fig. 3—Shank of indicating attachment. Fig. 4—Cross-section of assembled attachment.

When using the attachment, the screw is brought in contact with the button. The table is then set so that the two cylindrical parts of the attachment come practically in line. The indicator is then brought into contact. On revolving the spindle, there will be no movement of the indicator needle if the button is located centrally with the spindle. If the button is not located centrally, the outer portion of the attachment will run eccentric. This is caused by the fact that the shank revolves on the same center as the spindle, while the outer portion is prevented from doing so by the contact screw bearing on the button.

A Turret Tool for Ball Turning

BY HAROLD MOHAY

The arrangement of a fixture and turret tool, which is used for turning the ball handle on the end of the lever illustrated in Fig. 1, is shown complete in Fig. 2. As will be noted in Fig. 1, the ball end has a hole *B* drilled in it, this being used for locating purposes, while advantage is also taken of the beveled ribs, shown in section at *A-A*, for clamping and driving the work.

Considering first the fixture portion in Fig. 2, the work *X* is slipped over the pin *A* and also over the spring pin *B*, the latter being turned so as to bring the flats into the correct position for passing between the beveled ribs. The spring pin is then given a quarter turn, following which it is caused to clamp the work by tightening screw *C* against the beveled portion of it in the manner shown. It can be seen that the screw does not project above the surface of the plate, this construction being used for the sake of safety. The fixture is made to screw on the spindle nose, and it is provided with a flange at *D* so that the end of the work will not revolve unprotected in a manner dangerous to the machine operator.

Referring to the turning-tool mechanism, the body of it *E* is made from a steel forging, it being machined at *Y* to fit the turret hole of the lathe. The turning cutter *F*, shown in Figs. 2 and 3, is secured in its holder *G*, which is mounted in the body of the tool in such a manner that it pivots about a center (common to the center of the work) on the hinge pin *H* and the long hinge stud *J*. The cutter is held in place by the clamp *K* and screw *L*, the stud *J* carries a collar *M*, which is pinned in place to prevent the tool from moving up, and a pin *N* holds the hinge stud to the tool holder. In the upper end of this stud *J* a pin 10 in. long is used as a handle for revolving the tool about the center. Another pin *P* in the stud, in connection with a pin *Q* in the body of the tool, limits the movement of the cutter to the portion of the circle which is to be formed. In operation, the turret containing this tool is fed forward against a stop, and the operator then revolves the cutter by hand by means of the operating pin, thus forming the ball handle and the bevel as shown in Fig. 1.

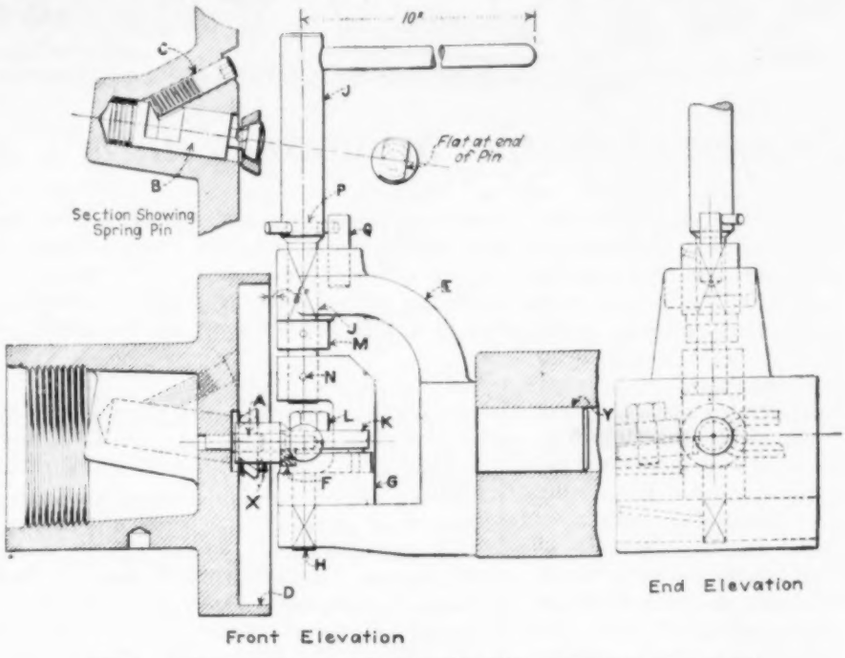


FIG. 2. TOOL ARRANGEMENT USED FOR TURNING THE BALL

For grinding the cutter and setting it on center in the tool, the gage shown in Fig. 4 is used. The end of the cutter is shaped to fit the form. To set the cutter in the holder, the edge *B* of the gage is held against the back edge of the cutter holder *G* and the cutter is moved forward until it reaches the formed edge *A* of the gage. This positively locates the cutter so that it will cut the correct diameter, this being a very important consideration where work of a reasonably uniform character is desired.

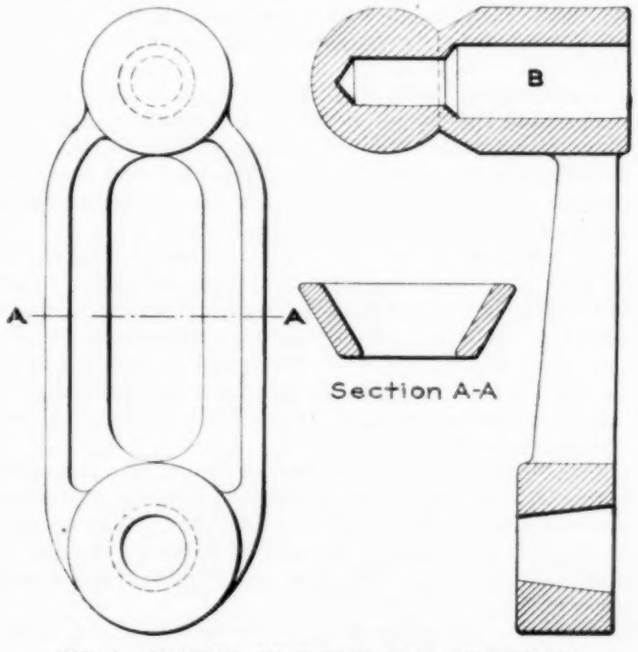


FIG. 1. HANDLE ON WHICH BALL IS TURNED

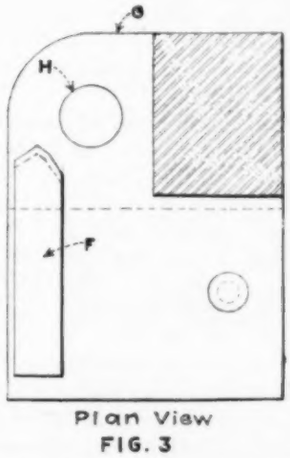


FIG. 3

FIG. 3. CUTTING TOOL IN POSITION IN THE HOLDER

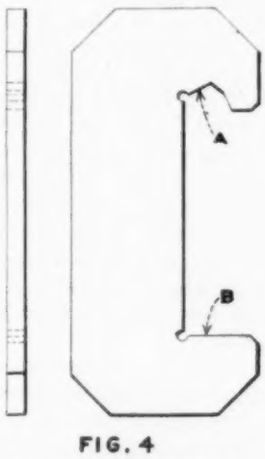


FIG. 4

FIG. 4. GAGE USED IN SHAPING AND SETTING TOOL

WHAT to READ —for the man in a hurry

Suggested by the Managing Editor

IN DEFERENCE to the American Steel Treaters' Society we are leading off this week with an article on material-testing machines by one of the big men in that field. The testing of the materials of construction, and particularly the metals, has grown in importance with the advances made in machine design, metallurgy and shop practice. And, fortunately, the improvement in the machines and devices for performing such tests has kept pace with the requirements of the tester. Mr. Olsen is probably as well fitted as any one to tell what has been done in the design and construction of testing machines. His article is illustrated by cuts of the important types.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

Another article of particular interest to steel treaters is the one on page 547 by the late Wilfrid Lineham of Goldsmith's College, London. It concerns the control of the hardening of screw gages in such a way as to minimize the distortion along the pitch line. The author started with the intention of discovering a quenching temperature at which distortion would be eliminated but he admits that his ideal was not attained although he got a long way on the road to it. His measuring apparatus is illustrated as are also the rather remarkable results of repeated heating and quenching of steel disks. (As this has been given wide circulation abroad we are omitting it from the European edition.)

Fred Colvin has had several discussions of successful management experiments in previous issues and he has mentioned the White Motor Co., of Cleveland, before. On page 531 he decribes their scheme of posting actual cost figures where the men can see them and also the organization of the company and of the representative committees. Results count in a system of this kind. You can judge for yourself whether it has been worth while.

If you are one of those who like to look back and yarn about the "good old days" which will never come again, R. Thomas Huntington's reminiscences on page 533 will call to mind experiences you hadn't thought of for years.

Viall's welding article this week takes up the equipment used for electric arc welding as well as a short statement of the two commonly employed methods. It starts on page 537.

The rest of the National Screw Thread Commission's Report on coarse and fine threads which was begun last week appears on page 543, and succeeding pages. Here the gage specifications are given in detail, tables of manufacturing tolerances are set forth and typical specifications for screw thread products are outlined.

Automotively speaking we are finding practical difficulties in being entirely logical in the presentation of our series on automobile practice. We still have some more of the comparative engine parts articles coming along but as we are still adding to our supply or data we find it convenient occasionally to slip in something on some other part of the mechanism even if it does seem to be out of its regular order. This is what has happened this week and we are consequently giving you something on front axles. Page 553.

On page 552, Frank H. Williams concludes very sagely that giving the employees what they want to read in a plant paper makes for the success of the paper. His particular theme this week is "frivolity" and his suggestions are pointed, not only for the editors of plant papers but possibly for other editors as well.

On page 564a under the heading "What Other Editors Think" are two unusually interesting editorials. One calls attention to the false economy of trying to make obsolete, inadequate or patched-up equipment in the railroad shops do the work that could be handled more cheaply by modern tools. It recommends a judicial balancing of the opposing policies of "make it do" and "get something better."

The other editorial comments on the results of a questionnaire sent out by the Merchants Association to find out the present status of labor efficiency. It is encouraging to note that the concensus of opinion indicates an improvement and a closer approach to "a fair day's work for a fair day's pay."

Our own editorials on page 559 will give you something to think about.

EDITORIALS

Preparation—Not Pessimism

THE curtailment of automobile production is doubtless the forerunner of other readjustments from the abnormal conditions of the past six years. But, while all readjustments disturb existing conditions to some extent, there should be no pessimistic fears as to the outcome.

The people of the United States are going to continue doing business. Not in the same old way, but in some other way which will be better for all concerned. We are going on; there can be no turning back, no giving up of our ideals or rights to "life, liberty and the pursuit of happiness" as has been our motto in the past.

Far-sighted business men accept a letting up of abnormal demand as an opportunity to put their plants in better order; to substitute more efficient methods for those which are known to be wasteful but which the press of business has made it impossible to change. They also have the opportunity to study ways and means of improving quality or of reducing manufacturing costs, or both.

Now is the time to look ahead and to plan for the future as well as for the present. Now is the time to ask ourselves if there are not ways of making our shop really more efficient.

New machinery has been developed which will cut costs tremendously in many lines of work. Now is the time to see if this is not just what we need to bring our methods up where they belong. Can we not adopt some of the automotive shop methods to other lines of work? Can not the textile field and the newly developed field of washing machines and other household appliances improve their methods so as to reduce the prices of their product and so widen their markets?

The one thing to be avoided is the feeling of pessimism or panic. Let us abandon all talk of "getting back to the good old times," for we never shall nor do we want to. But we can and must go forward to better times, with many of the inequalities of the war period ironed out or eliminated.

Neither wages nor standards of living are going back to the pre-war period. But we can and must come to some equitable basis both as to production and profits. In too many cases neither wages nor selling prices now bear a direct relation to production, or to production costs. Both these conditions are uneconomic, both are closely related and both are unjust. We cannot cure one without the other.

We have a right to demand a fair production per dollar of wage or per hour of shop operation. And the worker has the same right to demand that the cost of his shoes, clothes and all that go to make up his living expenses, shall be based on the cost of labor, material and a *fair* profit. Prices set to secure "all the traffic will bear" in the language of the old railroad freight agent, are especially dangerous during a period of readjustment.

Almost equally bad, however, is a panicky cutting of prices in the hope of keeping the plant going full time. If prices are too high, they should be placed at a fair figure. If they already allow only a reasonable margin of profit, reducing them is not good business. It may be a good time to increase production by laying the case squarely before the men something like this: "Our costs do not allow us to sell in competition with other shops. If we can increase production 10 per cent, we can secure orders enough to keep the plant in operation. We believe this can be done with your co-operation, without disturbing either bonus or wages. It's up to you."

Whatever the way, we are going forward. The machine-building industry is more necessary than ever before, and now is the time to prepare it for the days which lie ahead. F. H. C.

"Labor Also Is On Trial"

THE return of the railroads to private control coupled with the recent rate award of the Interstate Commerce Commission has given birth to the popular idea that it is now 'up to the railroad manager.' . . . Equally true, however, is the fact that another great element in our national life is also on trial. Not only must the railroad managers show their ability, but the men and women they employ must demonstrate their willingness to work and their right to the wages recently awarded them by the United States Railroad Labor Board." This is the beginning of a statement by E. E. Loomis, president of the Lehigh Valley Railroad, that appeared in *Railway Age*. It contains an idea that is worthy of close attention.

In the hectic times during and after the war the expression "What does he get?" has too completely suppressed the older, homelier term "How much does he earn?" We fear that there is little connection between the two terms at present and that if the amount many a man gets was reduced to the amount he earns there would be a break in the silk-shirt market. And the fault is not all with the workman.

This is not an argument to reduce wages—far from it. We believe in high wages, but we also believe that they should be earned. And we agree with Mr. Loomis that the average American workman is too ambitious and has too much sense to remain indefinitely on the same basis as the time-server.

But there remains much difficult missionary work to be done to persuade the American workman, or for that matter the average citizen, that it is impossible to get something for nothing for very long without bankrupting the community. It would seem that the horrible example of Soviet Russia should be sufficient to bring people to their senses but unfortunately this is not the case for it is not difficult to find many who are unconvinced.

The article on another page describing the system in vogue at the White Motor Co., gives an example of a plant where high wages are earned and indicates an attitude that might profitably be adopted in other plants and other industries. K. H. C.

A Chart for Lengths of Keys

By JOHN S. WATTS

There appears to be a certain degree of haphazardness among some designers when the question arises of the length of hub required on a gear or pulley to give a sufficient area of key to transmit the desired torsion. It seems to be the common method to make the hub project slightly on each side past the face of the gear.

ALL the text books give the width and thickness of keys to be used for various diameters of shafts, but give no data on which to base the length of the key, which condition of affairs is probably what has led so many to jump to the conclusion that almost any length of key will do.

Making the size of the key proportional to the diameter of the shaft is certainly desirable for the sake of uniformity, but except in those rare cases where the gear or pulley to be keyed transmits the whole power of the shaft, the diameter of the shaft is no criterion of the size of the key required. In fact, owing to the greater lever arm of the key, the larger the diameter of the shaft the smaller will be the section of key required to transmit a given turning moment.

It is clearly most desirable to have a standard width and thickness of key for each diameter of shaft, and I have therefore, in making up the accompanying chart, kept the width and thickness of key to a standard, and made it to show the length of the standard size key that will transmit the required torque at each diameter of shaft.

To use the chart, Fig. 1, follow along the horizontal line for the turning moment or torque, in inch pounds, to its intersection with the vertical line for the shaft diameter, and read the length of key required from the next higher diagonal line.

For example, a gear to transmit 400,000 in.-lb. on a 6½ in. dia. shaft will require a key 6½ in. long, or, what is the same thing, the hub of the gear should be 6½ in. wide.

The standard upon which the chart is based is a width of key equal to one-quarter of the diameter of the shaft and an allowable shearing stress on the key of 12,000 lb. per square inch.

The curved line indicates the torque which the shaft itself will transmit at a stress of 12,000 lb. per sq.in., and also shows the length of a key that will be equal in strength to the shaft. For instance, a key 10½ in. long in a shaft 6½ in. dia. will be equal in strength to the shaft, both being of the same material.

The depth of keyway is usually made one-third of the width of the key, which in the above case gives a compressive stress on the side of the key of three times the shearing stress, or 36,000 lb. per sq.in., which is allowable where the key fits on all four sides, and therefore the material in the key cannot deform under the pressure. If the key is fitted on the side only the depth of the keyway should be one-half of its width, thus reducing the bearing stress to 24,000 lb. per sq.in., or the length should be increased to keep the bearing stress down to that amount. If the gear is pressed tightly onto the shaft and the friction between the gear bore and the shaft can be depended upon to take part of the turning moment, then the key may be made to project only one-third of its width as before.

In all the above it is assumed that the key is a tight fit and the gear or clutch is immovable. The design of keys for sliding gears or clutches is a different proposition entirely. These should have a surface sufficient to reduce the bearing pressure on the side of the key projecting out of the shaft of not over 3,000 lb. per sq. in. The depth of the keyway in the shaft need not be increased over that required for fixed gears. This will usually involve fitting at least two keys which can be narrower than the standard as the shearing stress need not be reduced.

The chart is constructed as follows: draw the vertical line at the right and lay off on it to scale, the points representing the torgue in inch-pounds, and draw horizontal lines through each of these points.

We now locate upon this vertical line the points corresponding to the shearing strength of the standard size of key in an 8-in. shaft, expressed in inch-pounds for each inch and half-inch of length. That is, a key 2 in. wide and 1 in. long will have a resistance in shear at 12,000 pounds stress of $2 \times 1 \times 12{,}000 = 24{,}000$ lb., and at the lever arm of 4 in., due to the radius of the 8-in. shaft, this gives a torque of $24{,}000 \times 4 = 96{,}000$ in.-lb. for each inch of length of key.

The formula for the moment of resistance of a key one inch long is:

$$\text{Moment of resistance} = M_r = W \times \frac{D}{2} \times f \times 1$$

where W = width of key in inches
D = diameter of shaft in inches
f = allowable shearing stress

But as $W = \frac{D}{4}$ substituting in the formula, we get

$$M_r = \frac{D}{4} \times \frac{D}{2} \times f = \frac{D}{8} \times f$$

As the resistance of the key varies with the square of the diameter of the shaft, we therefore make the base line of the chart, equal to $8^2 = 64$, in length to any convenient scale, because we have taken the vertical line to represent the resistance of the keys in an 8-in. shaft. To the same scale we lay off points for the other diameters of shafts, making the lengths equal to the squares of the diameters and erecting vertical lines at each point.

Now we join the points in the 8-in. vertical line to the zero end of the base line, and it follows from the law of similar triangles that the height of any diameter line to any diagonal line is equal to the moment of resistance of a standard size key of that length indicated by the diagonal line, in a shaft of the diameter indicated by the vertical line.

The curved line is arrived at by scaling up on each diameter vertical line, the torsional strength of that diameter of shaft in inch pounds at a stress of 12,000

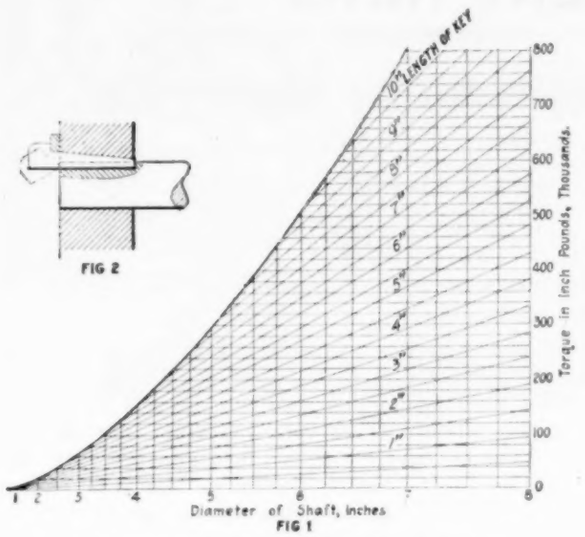


FIG. 1. CHART FOR LENGTHS OF KEYS
FIG. 2. HOW AN UNSUPPORTED GIB KEY CAN BE BROKEN IN REMOVAL

pounds, and drawing the line through the points so acquired.

In passing it may be noted that a key having a width of one quarter of the diameter of the shaft and a length of 1.5708 times the shaft diameter will develop the full strength of the shaft, both shaft and key being under the same stress and being of the same material.

There is another point in fitting keys that is worthy of more attention than is usually given to it. This is making provision for driving out the keys when repairs render it necessary to dismantle the gears.

Where it is impossible to provide space to enable the key to be driven out by means of a key drift against the small end of the key, the large end of the key should have a gib head so that it can be extracted by wedges driven between the gib head of the key and the hub of the gear.

These gib heads are the cause of considerable profanity in the repair shop when they are fitted in a shaft cut off flush with the face of the hub of the gear (which is the way they are nine times out of ten). Under these conditions a key that has been well fitted originally and driven tightly home, especially if it has been in place a long time, will almost every time break off at the head when the wedges are being driven in to extract it.

This can be seen by reference to Fig. 2 which shows that the strain on the head must be severe before much pull can be got on the key.

This trouble can be easily prevented by extending the shaft out about one inch to provide a support underneath the key when being wedged out.

Is This a Punch-Press Job?

By William J. Becker

Referring to Mr. Hudson's article, "Is This A Punch-Press Job?" on page 1,267, Vol. 52, of the *American Machinist*, the accompanying sketches should be of interest. I designed this fixture, shown in Fig. 1, a year ago for just the kind of a job about which Mr. Hudson inquires. It is made of angle iron and cold-rolled steel and used on a 24-in. shaper. Two screws at the end of the fixture will securely clamp a whole row of bars or wires. Care must be taken to put the proper taper on the clamps, so that they will force the wires down, but not too tightly. The clamping arrangement is shown separately in Fig. 2.

A fixture like this can be made to hold two $\frac{5}{16}$-in. wires per in. of fixture length, so that 48 wires can be machined at one setting on a 24-in. shaper. For a wire smaller than $\frac{1}{4}$-in. in diameter the clamps must be made sufficiently wide and close together to prevent springing while machining. A straight-edge can be clamped to the fixture to act as a stop against the ends of the wires.

Referring to the illustrations, *A* is an angle iron bolted to the shaper table, and the pieces *B* are bars of cold-rolled steel. The case-hardened clamps *C* swing between the bars *B*, and they are set just low enough to clear the cutting tool. Small pins *D* prevent the clamps from falling down into the slots. The heavy setscrew *E* clamps all bars at once. It is necessary that the work be supported as much as possible under the part being machined.

This fixture has been in constant use in the plant, and after doing duty for a year is still turning out work as rapidly and accurately as the day it was first used. It can be unloaded and reloaded in less than one minute and is easily kept clean.

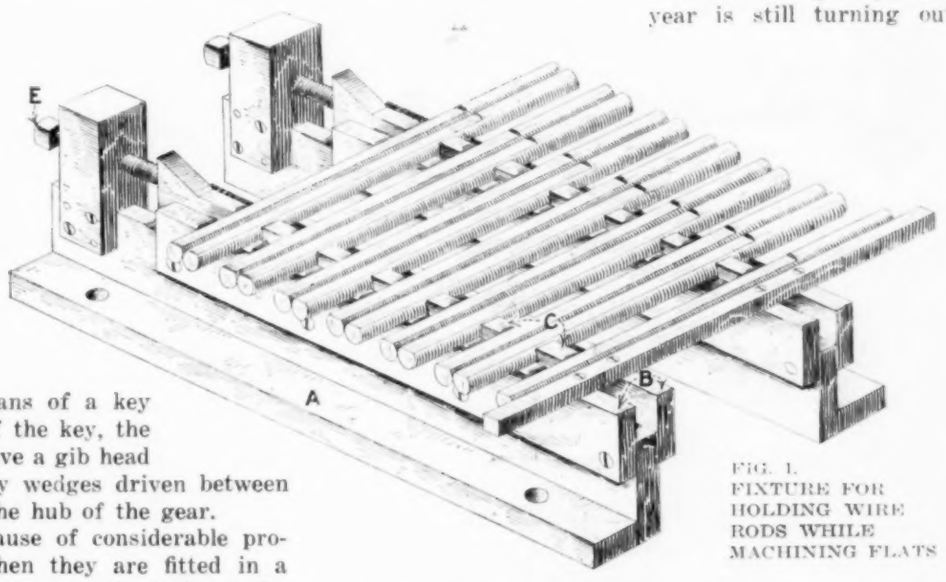


FIG. 1. FIXTURE FOR HOLDING WIRE RODS WHILE MACHINING FLATS

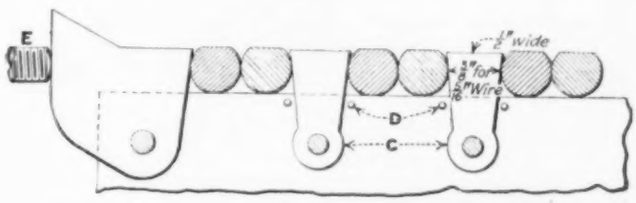


FIG. 2. METHOD OF CLAMPING RODS IN FIXTURE

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

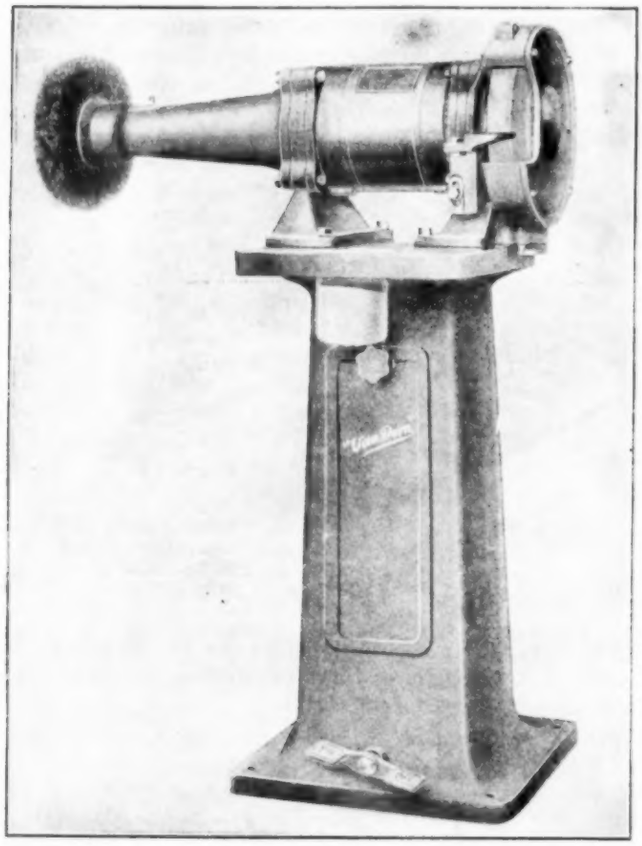
SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Van Dorn Heavy-Duty Electric Grinding and Buffing Machines

The Van Dorn Electric Tool Co., Cleveland, Ohio, is now manufacturing 1-hp. heavy-duty electric grinding and buffing machines in the floor, bench and aërial types. The motor is built and rated according to A.I.E.E. standards. It is claimed that it has a normal capacity of 1¼ hp., a momentary overload capacity of 2¼ hp., and will drive 10 x 1½-in. abrasive wheels without stalling. With ventilation, the rise in temperature in continuous service is less than 50 deg. C. (90° F.); when fully inclosed, the rise will not exceed 55 deg. C. (99° F.) in 30 min. at 1¼-hp. load. Ventilation is provided by means of a fan drawing air through screened openings at the rear of the frame.



VAN DORN 1-HP. ELECTRIC FLOOR GRINDING AND BUFFING MACHINE

Specifications: Height of spindle, 39 in. Base size, 17 x 18 in. Spindle diameter at wheel, ¾ in. Weight of machine with one guarded wheel and one extension, as shown: net, 345 lb.; crated, 450 lb.; boxed for export, 500 lb. Contents, boxed for export, 21 cu.ft.

When direct current is used the speed is 2,000 r.p.m. while the alternating-current machine runs at 1,800 r.p.m. The a.c. stator and d.c. field assembly are interchangeable in the motor frame, so that the machine can be changed from one type of current to the other at minimum expense. The diameter of the frame is smaller than the diameter of the wheel, so that long work may be placed flat against the wheel face. The shaft is mounted in ball bearings inclosed in dustproof housings. Heavy non-removable guards are provided, arrangement being made for the attachment of an exhausting system. Extensions for carrying brushes or wheels can be furnished, as shown. The aluminum water pot is removable, and tool rests having both horizontal and vertical adjustments are provided

The floor type of machine, shown in the illustration, has a foot-operated switch, an automatic starter being placed inside the pedestal when a d.c. motor is used. D.c. machines can be furnished to operate on either 115 or 230 volts, and a.c. machines in either two or three phase on 110, 220 or 440 volts.

The machine can be furnished as an aërial grinding machine carrying a single wheel and having an over-all length of 33¾ in. and a net weight of 85 lb.

Van Keuren Combination Reference Gages

The Van Keuren Co., 362 Cambridge St., Allston, Boston, Mass., has added to its line sets of combination precision-gage blocks. The blocks are intended primarily as reference standards. It is claimed that the round or cylindrical shape gives the proper distribution of metal for a reference gage, as temperature changes affect the block uniformly.

The gages are made of an alloy tool steel which is said to have been selected for its properties of long wear, constancy of size and shape, uniformity and freedom from corrosion. They are given a seasoning or aging process.

The gaging surfaces are lapped to a mirror finish, and the blocks are guaranteed to be correct in size, flatness and parallelism within 0.00001 in. of the nominal marked dimensions. The gages are standardized by light-wave measurement with standards certified by the National Bureau of Standards. A serial number is stamped on each one to facilitate the keeping of records as to the accuracy of the gage both when new and during its life.

VAN KEUREN COMBINATION SET OF REFERENCE GAGE BLOCKS

The gages are arranged in various sets to meet the requirements of both large manufacturing concerns and individual mechanics. The set shown herewith contains five sizes in the binary fractions of an inch, namely, 1, ½, ¼, ⅛ and 1/16 in. With this set all sizes in sixteenths of an inch may be assembled in combination, making 31 sizes in all.

Electro-Magnetic Portable Grinding Machine

The Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill., is now building a portable grinding machine known as type 2UA. One of the chief features of the machine is the interchangeability of the pulleys, which permits its use either for internal grinding with a high-speed spindle, as shown in Fig. 1, or for external grinding, tool grinding or similar work with a slower speed and larger wheel, as in Fig. 2. The wheel may also be carried on an extension of the armature shaft.

The machine is furnished with a base or angle plate

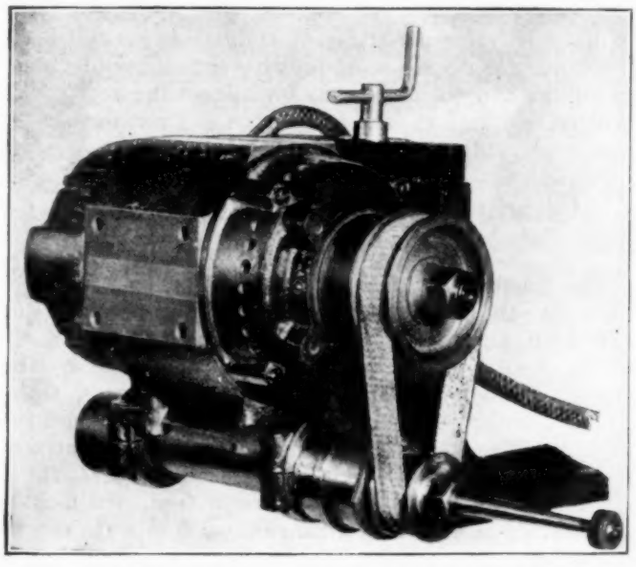


FIG. 1. ELECTRO-MAGNETIC PORTABLE TOOL ARRANGED FOR INTERNAL GRINDING

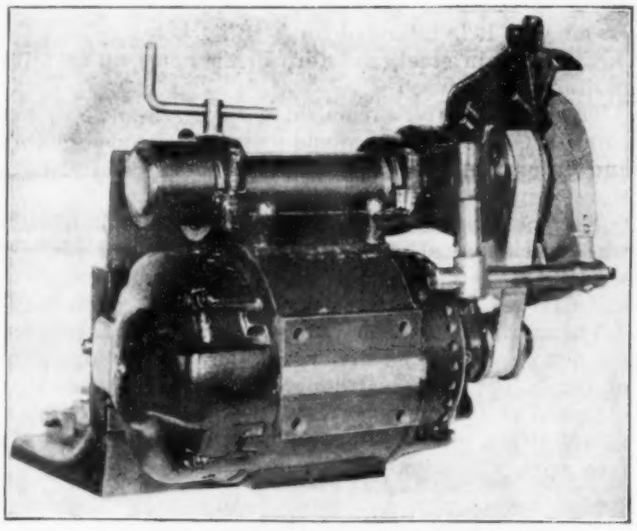


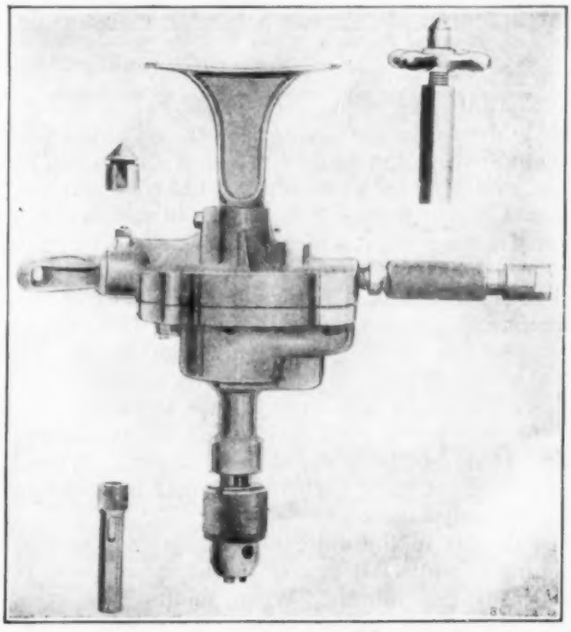
FIG. 2. PORTABLE GRINDING MACHINE WITH LARGE-DIAMETER WHEEL

suitable for mounting it in position on either the carriage of a machine tool or a bench, and slides are provided for vertical and horizontal adjustments. The motor body has flats finished on the top, bottom and outside faces, so that the spindle may be shifted to get it in the proper position.

Spindle extensions 5, 10 or 15 in. long may be attached for internal grinding. The armature speed is about 5,200 r.p.m., and the large pulley is approximately three times the diameter of the small one. A 5½- to 6-in. wheel can be used when operating at the slower speed. The motor is about ¼ hp., and the total weight of the tool, without equipment, is 25 lb.

Turbine Jr., Pneumatic Drill

The Turbine Air Tool Co., 710 Huron Road, Cleveland, Ohio, has brought out the portable pneumatic drill shown in the illustration. The machine operates on the turbine principle, being known as the Turbine



TURBINE, JR., PORTABLE PNEUMATIC DRILLING MACHINE

Jr. model. It is intended for drilling holes up to ½ in. in diameter in steel, and for boring holes up to 1 in. in diameter in wood.

The drill can be furnished with a screw feed, top point, breast plate and spade grip that are detachable and interchangeable, also screw chucks and No. 1 Morse taper socket.

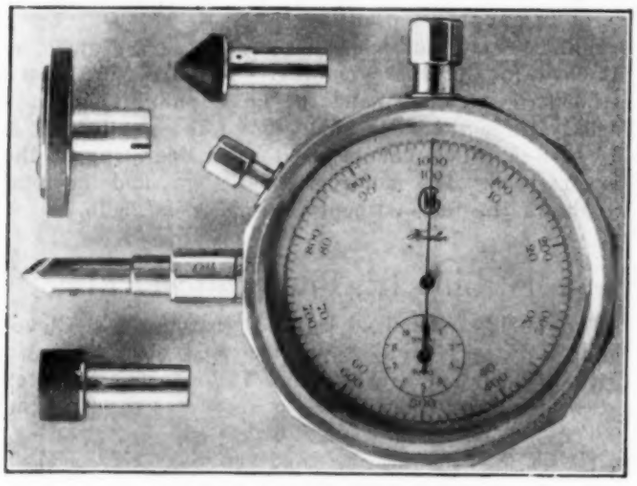
The housing and the turbine are made of aluminum, while nickel steel gears and vanadium steel pinions are employed. There are only fifteen primary parts and four wearing parts. The weight is 9 pounds.

The air consumption is given as 20 cu.ft. of free air per minute. The drill will operate on a pressure of 60 lb. per sq.in., although maximum efficiency is obtained at 100 pounds. The speed is controlled by a valve on the inlet. It is claimed that the machine is free from vibration and smooth in operation.

Hasler Speed Indicator

C. H. Boulin, 82 Duane St., New York, has placed on the market the Hasler speed indicator shown in the accompanying illustration.

This instrument will count speed during a period of three seconds and show on the dial the result in terms



HASLER SPEED INDICATOR

of revolutions per minute or yards per minute. No watch is needed as the timing is obtained automatically, thus eliminating the danger of error due to the necessity of observing both a watch and the counter.

In use, the instrument is placed in connection with the shaft, the revolutions of which are to be counted. Pressing the large button at the top sets the interior mechanism in motion. After running for three seconds this connection is automatically broken, while the hands remain in the reading position. The hands may be brought back to zero by pressing the smaller button at the side. When it is desired to take two or more readings for the purpose of verification or averaging, the hands should not be brought back to zero. When they are not brought back, each reading will be added to the one previously taken.

The figures in the outer circle represent revolutions per minute, while the figures in the inner circle represent yards per minute. When finding the speed in yards the small wheel shown is mounted on the spindle and held on the periphery of the work as it revolves.

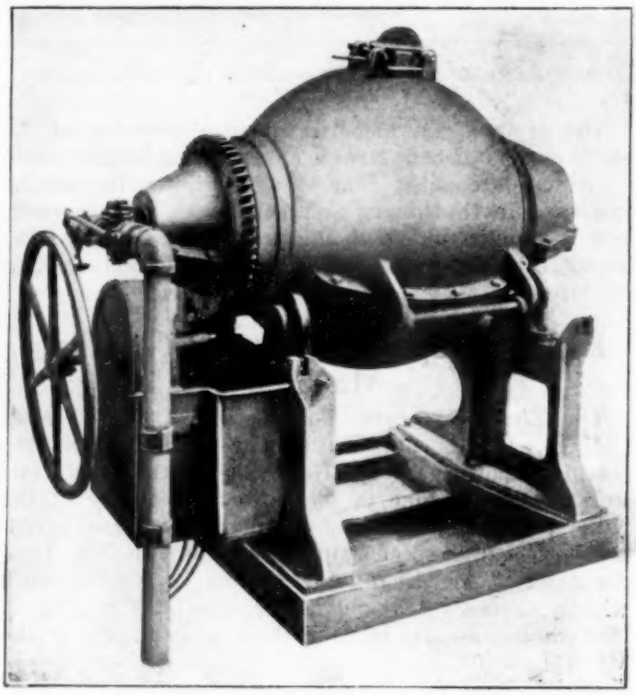
Speeds up to 10,000 r.p.m. or 1,000 yds. per minute can be counted each thousand revolutions or 100 yards being shown on the small dial.

The case is made of aluminum and the total weight of the instrument is less than 10 ounces.

Monarch Revolving Melting Furnace

The Monarch Engineering and Manufacturing Co., Baltimore, Md., has recently brought out the furnace illustrated, a development of its Simplex type. The furnace is non-crucible and revolves continuously during melting. It is motor-driven. A handwheel is provided for a limited amount of hand rotation. The burner is at one end; charging, skimming and venting of gases take place at the other end.

It is claimed that rotation increases the life of the linings and decreases the melting period. The furnace



MONARCH REVOLVING MELTING FURNACE

is designed for the melting of metals for general casting work, for disposing of foundry refuse such as slag, grindings and washings and for recovering soft metal drosses, skimmings and sweepings. This furnace is also made with double chamber.

Changes in Lambert Horizontal Boring Machines

The Lambert Horizontal Boring Machine, formerly built by the Lambert Machine & Engineering Co., Cleveland, Ohio, and described on page 270, Vol. 49, of the *American Machinist*, is now being built by the Carroll Foundry & Machine Tool Co., Bucyrus, Ohio.

The number of feeds of both the boring bar and the table has been increased from 16 to 32. Extra attachments, including an auxiliary table 8 in. x 4 ft., a circular table with or without worm feed, and a star-feed facing-head having a range from 0 to 3 ft., can be furnished.

In addition to the above, the machine can be arranged for motor drive through a silent chain.

What Other Editors Think

Economy May Mean Spending

From *Engineering News-Record*

NEARLY every proverb has its antithesis. Thus, on the one hand there is the advice to "do the best with what we have" and on the other it is urged that "the best is the cheapest." The conflict between these contrasting lines of policy in engineering work is suggested by discussions at the annual meeting of the mechanical section of the American Railroad Association. It appears that in many cases the policy of utilizing old plant and following old methods is being carried to a point where it results in direct waste and loss.

The common reason or excuse assigned is inability to obtain money. But under the conditions noted it should not be difficult to demonstrate conclusively that small immediate expenditure may mean a direct and continual saving. Have the men with the knowledge and responsibility failed to make this demonstration successfully?

In car repair work, for instance, it is still common practice to have gangs of men with jacks raise the car bodies from the trucks, a slow and troublesome job. If this was occasional work the practice might be justified, but it is work that goes on day after day, year in and year out. An overhead crane or gantry would do the work in less time and with fewer men, while the men would put in their time on productive repair work instead of non-productive hoisting. The same conditions may be found in some locomotive repair shops, where small and old machines are strengthened, modified or coaxed to do the necessary work of modern equipment.

In some cases this may be true economy. But in many more cases it means loss of time and energy, high cost of work and waste of material spoiled or given ineffective treatment.

These conditions are not peculiar to the railways but occur more or less in all lines of industry. In construction work, for example, there is frequently a tendency to use old or inadequate equipment in order to save expense. But if this results in delaying the work by breakdowns or insufficient capacity, the financial loss may far exceed the cost that would have provided more satisfactory equipment, to say nothing of the worry, friction and possible ill feeling between the contractor and the engineer or owner. In rarer cases there is the unnecessary expense of special employment, the cost of which is not justified by the work or the results. Such excess of plant may prove a losing investment.

What is needed is more careful exercise of judgment as to the relations between the plant and the work, as well as the relative economy of saving and spending, with a wider realization of the fact that direct saving may result from spending and that avoiding expense is not necessarily economy.

In other words, a more judicial balancing of the opposing policies of "make it do" and "get something better."

Labor More Efficient

From *New York Commercial*

AS A RESULT of a questionnaire sent out by the Merchants Association, large manufacturers report that labor is, on the whole, increasing its efficiency, especially where piece work is in vogue.

Some of these manufacturers declare that it is not the result of any conscience stricken attitude on the part of labor, but simply because they have come face to face with facts. In a number of lines of industry where demand has fallen off, there have been either temporary, partial, or complete shutdowns, serving notice upon labor that the limit of endurance has been reached.

In New England, where the woolen mills have closed down, much suffering is already in evidence, and there is talk of resorting to court proceedings to force the American Woolen Co. to open, and so forth. Apparently it makes a difference whose ox is gored. Talk of using court proceedings to force labor to work if it wants to strike would bring forth tremendous tirades on the "enslavement of the toilers" and "personal liberty." When the shoe is on the other foot, however, courts and injunctions might be classed along with the small boy's definition of a lie: "An abomination of the Lord, and a very present help in time of trouble."

However, it is not at all likely that any edict of a court could force a woolen company, or any other kind of a manufacturing concern, to spend money to keep labor employed at high wages, when it is impossible to sell the goods they manufacture, except at a loss.

What has happened in the woolen trade and a number of other lines is precisely what is going to happen generally, unless labor adopts a different attitude, for the public has the final say in such matters. When labor costs have forced prices up to a point beyond which the public is willing to go, manufacturing has to stop.

No sane person wants to see unemployment spread or wages forced down to a level that will not provide comfortable living for the workers. The country's whole attitude has undergone a change in that regard. The public is willing to pay a little more for goods if it means better living condition for the workers, and capital also realizes that times have changed and that the worker is entitled to a little larger share of the profit.

Forcing selling prices to prohibitive levels through greed on the part of either labor or capital simply reacts upon the greedy element. Capital has had its turn in being greedy, and has lost out, and now labor is going through the same experience. Labor has gained a great deal in the past few years, much of which it is legitimately entitled to, but recently there has been a tendency to overshoot the mark; in which case it will fall afoul of natural laws and force a readjustment which may undo far more of that which it has accomplished than the general welfare demands. Labor can prevent this by adopting a reasonable attitude, the controlling principle of which is a willingness to furnish a fair day's work for a fair day's pay.

The Manufacturer Should Provide the Necessary Guards

FROM *Utilities Mutual "Protection"*

"JOHN S., while working at a multiple boring-mill, had his hair caught in one of the universal joints above the drill-spindles. His head was badly cut and bruised and a portion of his hair was pulled out. This was a brand new tool, and, having just come from the factory, we thought it was complete as shipped and did not realize that it was necessary to add more guards to it."

This brings up a subject of increasing importance to the man who sees his compensation rate subjected to a decided penalty on account of the exposed parts of his new machines. A piece of machinery should, on leaving the works, be complete in every possible way. A guard over dangerous moving parts is just as much a proper piece of the machine as are the working parts themselves. And yet, how often do we see drill presses, planers, shapers—metal and wood working appliances of all kinds—with the gears and pulleys quite unprotected. While, of course, it is manifestly impossible for the manufacturer to provide guards for driving-belts under the greatly varying situations under which his machines will be set up, it seems unreasonable to expect the purchaser to add standard fittings which could so much more satisfactorily be made a part of the original design in the shop where these were built. And how much easier it would be for all concerned to know that the tool, when it was set up, was complete in all respects and would successfully comply with all the underwriters' requirements.

It would seem that, however faithfully "safety first" is practiced in the foundry and shop of many manufacturers, there is still room on several of their drafting boards for the application to their own designs of the principles which their shop superintendents so ardently advocate.

We are glad to note that there is a growing demand on the part of many of our assured for the purchase of fully guarded apparatus. We would like to see it universally laid down as a hard-and-fast rule that engineers, superintendents and purchasing agents should buy no new machinery which was not thoroughly equipped with the requisite and suitable guards over everything which could, in the language of the Rating Code, be construed as "a dangerous moving part, exposed to contact." This would not only decrease the accident hazard to the men, but also would relieve the master mechanics of the bother and inconvenience of making out of such material as they happen to have on hand, makeshift guards which are not only costly, but which also are apt to be a blemish on the beauty of a new and expensive machine.

Die Casting*

BY CHARLES PACK
Doehler Die Casting Co., Brooklyn, N. Y.

Data on die casting have not been widely disseminated, as the more important developments in the die-casting process have taken place within the last few years. This fact will make very acceptable the accompanying analytical treatise, in which the author outlines the general properties of the alloys used, their fields of application and their limitations.

DIE CASTINGS may be defined as castings made by forcing molten metal, under pressure, into a metallic mold or die. It is erroneous to assume that all die castings have similar properties, since it is apparent that the properties of the die casting will depend upon the nature of the alloy used. The die-casting process is best adapted to alloys of comparative low fusing points which may, for convenience, be divided into the following groups:

Group A. Zinc Alloys, consisting essentially of zinc alloyed with tin, copper or aluminum.

Group B. Tin Alloys, consisting essentially of tin alloyed with copper, lead or antimony.

Group C. Lead Alloys, consisting essentially of lead alloyed with tin or antimony.

Group D. Aluminum Alloys, consisting essentially of aluminum alloyed with copper.

No general rules can be laid down governing the design and application of die castings since the art depends largely upon the skill of the designers, and quite frequently a part may be considered as impractical from a die-casting standpoint which, if measured by given standards, may be redesigned and die-cast very successfully. Nevertheless the writer will endeavor to outline briefly the general properties of the alloys used, their fields of application and their limitations.

*From *Mechanical Engineering*, August, 1920.

GROUP A—ZINC ALLOYS

TYPICAL ALLOY:

Zinc	87.5 per cent	Aluminum	0.5 per cent
Tin	8.0 per cent	Copper	4.0 per cent

PROPERTIES:

Color	Silver white
Weight per cubic inch	0.253 lb.
Melting point	780 deg. F.
Initial fusing point	275 deg. F.
Tensile strength	16,100 lb. per sq.in.
Elongation	2 per cent
Compressive strength	27,670 lb.
Pressure required to shorten bar 1 in. diameter	10 per cent
Hardness number (Brinell)	64.6

CASTING LIMITS:

Maximum weight for casting	8 lb.
Minimum limit of wall thickness	$\frac{1}{16}$ in.
Small castings	$\frac{1}{32}$ in.
Variations from drawing dimensions per inch of diameter or length	0.001 in.
Cast threads, minimum number, external	26 per inch
Internal	Depends on conditions, often cast
Cast holes, minimum diameter	0.031 in.

Depending largely upon the depth and thickness of casting

Draft: Cores, 0.001 in. per inch of length or diameter.
Side walls, 0.001 in. per inch of length.

General Design. Sections of castings should be as uniform as possible. Sharp corners should be avoided and fillets added wherever permissible. Undercuts in castings should be avoided wherever possible.

General Remarks. Alloys of this type are corroded by any alkaline or aqueous solutions of any salts. Castings may be polished to a high luster, but soon

tarnish when exposed to ordinary atmospheric conditions.

Castings made from this alloy may be readily plated with nickel, copper, brass, silver or gold. When properly plated such castings will retain their luster as well as those made from brass or bronze.

Applications. Castings made from this alloy should not be used for parts that are subjected to severe stress or sudden shock in service. They are used extensively for parts of phonographs, calculating machines, drinking-cup, cigar, candy, stamp and gum vending machines, magneto housing, automobile-body trimmings, pencil-sharpening machines, time-recording devices, stamp-affixing machines, and for many other devices of a kindred nature.

Group B—Tin Alloys

Typical Alloys	Tin, per cent	Copper per cent	Lead, per cent	Antimony, per cent
No. 1	90	4.5	0	5.5
No. 2	86	6	0	8
No. 3	84	7	0	9
No. 4	80	0	10	10
No. 5	61.5	3	25	10.5

Alloy No. 1 is a so-called "genuine babbitt" metal and was used very extensively during the war for main-shaft and connecting-rod bearings on all American-made airplanes and motor trucks. No. 2 is somewhat harder and is used extensively for bearings of internal-combustion engines. No. 3 is somewhat harder than alloy No. 2 and is the S. A. E. standard for high-grade internal-combustion-engine bearings. No. 4 is in general use for light bearings on stationary motors. No. 5 is a bearing metal for light duty and is used on a large number of moderate-priced automobiles for main-shaft and connecting-rod bearings.

In addition to the five compositions mentioned, hundreds of similar alloys may be made having various specific properties. A study of these alloys, however, would prolong this paper unduly, and in the opinion of the writer, is beyond its scope. The die-casting process, it may be said, is applicable to any of the alloys of this group and it may be left with the engineer to use his judgment in specifying the alloy best suited to his requirements.

General Properties:
Maximum fusing point....450 deg. F.
Weight per cubic inch....Depends on lead content
Casting Limits:
Maximum weight for casting....10 lb.
Limit in wall thickness....$\frac{1}{32}$ in.
Variations from drawing dimensions per inch of diameter or length....0.0005 in.
Cast threads, minimum number:
External....27 per inch
Internal....Depends on conditions, often cast
Cast holes, minimum....0.031 in. diameter, depending on depth and thickness of casting
Draft: Cores, 0.0005 in. per inch of length and diameter.
Side walls, 0.001 in. per inch of length.

Applications. Tin alloys find their largest field of application in their use as bearings for internal-combustion engines. They are also used for parts of soda fountains, cream separators, milking machines, surgical apparatus, galvanometer parts, player pianos, etc., where a tensile strength of over 8,000 lb. per sq.in. is not essential and where resistance to corrosion is of importance.

They are not affected by water, weak acid or alkaline solutions, and when free from lead, are extensively used for food-container parts.

Group C—Lead Alloys

Typical Alloys	Lead, per cent	Tin, per cent	Antimony, per cent
No. 1	83	0	17
No. 2	90	0	10
No. 3	80	10	10
No. 4	80	5	15

Alloy No. 1 is generally known as C. T. (Coffin Trimming) metal, due to its extensive use in the manufacture of coffin trimmings. This alloy is also a good bearing metal for light duty and is used for thrust washers and camshaft bearings on light internal-combustion engines. No. 2 is somewhat softer and more ductile than No. 1. No. 3 is used extensively for light bearing duty, being somewhat tougher and stronger than Nos. 1 and 2. No. 4 is somewhat harder than No. 3 but less ductile. Many similar alloys may be compounded, all of which may be die-cast readily.

General Properties:
Weight per cubic inch....Depends on lead content
Maximum fusing point....600 deg. F.
Casting Limits:
Maximum weight for casting....15 lb.
Minimum wall thickness....$\frac{1}{32}$ in.
Variation from drawing dimensions per inch of diameter or length....0.001 in.
Cast threads, minimum number:
External....24 per inch
Internal....Depends on conditions, often cast
Cast holes, minimum diameter....0.031 in., depending on depth and thickness of casting
Draft: Cores, 0.0005 in. per inch of length and diameter
Side walls, 0.001 in. per inch.

Applications. Lead alloys may be used where a metal of non-corrosive properties is desired and where a tensile strength of not over 8,000 lb. per sq.in. will suffice. They are used extensively for fire-extinguisher parts, low-pressure bearings, ornamental metalware, and many parts that come in contact with corrosive chemicals. They should not be used for parts that may come in contact with foods or that may be handled often in service, since the poisonous properties of lead and lead alloys are well known.

The main advantage of these alloys lies in their comparatively low cost, but their high specific gravity must be considered.

During the war lead alloys were used for all hand-grenade fuse parts and many millions of these parts were made. Lead-alloy die castings were also used for thermite grenades, offensive grenades, trench-mortar fuse plugs and many other parts where a non-corrosiveness was an essential requirement.

Group D—Aluminum Alloys

Typical Alloys:
Aluminum, 92 per cent; copper, 8 per cent.
Properties:
Color....Silver white
Weight per cubic inch....0.115 lb.
Melting point....1,150 deg. F.
Tensile strength....21,000 lb. per sq.in.
Elongation....1.5 per cent
Hardness number (Brinell)....60.5
Casting Limits:
Maximum weight for castings....5 lb.
Minimum wall thickness....$\frac{1}{16}$ in.
Variation from drawing dimensions per inch of diameter or length....0.0025 in.
Cast threads, external, minimum number....20 per inch
Threads are cast oversize 0.01 in. to be chased to size. Internal threads rarely cast.
Cast holes: Minimum diameter 0.093 in. and not deeper than 1 in. Larger cores may be cast much deeper; smaller holes may be spotted to facilitate drilling.
Draft: Cores, 0.015 in. per inch of diameter or length. Side walls, 0.005 in.

Cores of less than ¼ in. diameter to have 0.005 in. draft per inch of length and diameter.

The composition described above is well known in the arts as No. 12 alloy and is used very extensively for automobile and airplane parts. By varying the copper content harder or softer alloys may be obtained, all of which may be die-cast successfully.

Applications. Aluminum die castings find wide employment in the manufacture of parts of automobiles, such as spark and throttle control sets, magneto parts, battery ignition and lighting systems, speedometers, etc. They are also used for parts of vacuum sweepers, phonographs, milking machines, vending machines, etc.

Brass and Bronze Die Castings

Die castings made from various types of brasses and bronzes were put on the market as early as 1910, but have never been successful commercially. At the present time there is only one die-casting manufacturer producing brass die castings in any appreciable quantity.

It is a comparatively simple matter to produce a small quantity of sample brass die castings, but no material has yet been found for die-making purposes, which will withstand the continuous action of molten brass and at the same time retain its shape, surface and size. The die casting of brass and bronze must be considered as in the experimental stage at the present time, with little or no immediate prospect of the solution of the problem.

Developments Due to the War

The most important development in the art of die casting during the war was the perfection of the process of die casting aluminum and its alloys. A suitable steel was developed for making the dies for this process that would withstand the action of molten aluminum without cracking, a problem the solution of which was essential to the development of the industry.

The part that this development played in the winning of the war will be readily appreciated when it is stated that at the cessation of hostilities there were being produced about one million aluminum die castings daily in this country for parts of gas masks, machine guns, airplanes, motor trucks, motor ambulances, surgical instruments, canteens, field binoculars, and many other appliances of war.

Comparative Cost of Die Castings

The cost of die-castings cannot be computed on the pound basis since it depends on the design of the piece, the number and position of the cores, the quantity to be produced and certain other factors. For comparative purposes it may be stated that at the present time tin-alloy castings are the highest in cost, being followed by those of aluminum alloy, zinc alloy and lead alloy in the order named.

In considering the use of die castings it is well to bear in mind that on a pound basis die castings are far more expensive than iron sand castings where the machining cost is not considered. As the zinc alloys, whose properties are similar to cast iron, cost from $200 to $275 per ton in ingot form, it is apparent that the substitution of a die casting for an iron casting can only be considered when the machining cost is sufficient to compensate for the difference in cost of the raw materials.

How Can We Increase Production?

By Harry Senior

On page 385 of the current volume of *American Machinist* George Sidney Binckley asks the above important question, sets up several possible answers and then proceeds to batter them all down but one; thus arriving at the desired solution by process of elimination.

This is an excellent method. It has been expounded before—notably in certain works of detective fiction—and seldom fails to disclose the real solution in those cases where the problem has been carefully constructed beforehand by the person who is to solve it.

We have in the above question, however, a problem in the construction of which we had no conscious hand. It has been set for us by Mother Nature (not the less nature because it is *human* nature) and certainty of the correctness of our solution by the elimination method rests upon at least two things: First. we must know all possible solutions; second, we must know that there is but one practical solution; and that none of the elements of that one are bound up with, or in any way dependent upon, those that are to be eliminated. To make our success really satisfactory involves also a knowledge of how to apply the remedy indicated by our solution.

Three Possible Answers

Mr. Binckley sets up only three possible answers to the question; three human emotions to which appeal may be made for the purpose of securing the willing co-operation of other men: these are (in effect) fear, honor and cupidity. Of two of these he promptly disposes; the first not because it won't work but because it is a two-edged sword, as likely to cut coming as going; and the second because it is "uncertain, erratic and never permanent." Thus there is left only cupidity—perhaps the most sordid of human emotions—as a basis upon which to build increased production.

Mr. Binckley may be right; but that he has his doubts (as I have mine) is strongly indicated in his summing up, under the head of "Co-operative Individualism." Many interpretations might be placed upon this phrase, but to him it seems to mean a *"square deal all around."*

There are, I believe, many more than three possible solutions to the problem of securing co-operation; more than three emotions to which appeal may be made. In fact in a moderate-sized shop there is little likelihood that any two workmen will display exactly the same combination of characteristics; will yield to the same kind of treatment. I have myself during my short, sharp, but not yet decisive career, succeeded in persuading a goodly number of men to do just what I wanted them to do, but, although I am perfectly willing to admit that I don't know how I did it, I have never yet resorted to bribery, nor do I remember that any workman, even an apprentice boy, was ever seriously afraid of me.

I must also admit that I have on certain occasions failed conspicuously; but I am unwilling to believe that I might have succeeded in many of the latter cases by "making it worth the while" of the recalcitrant one.

To say, as Mr. Binckley does, that to "make it worth his while" is an infallible means of securing a

man's co-operation is to set aside all the finer instincts of mankind and cheerfully admit that all men are out for what they can get, regardless. Our civilization, such as it is, is in itself sufficient refutation of this theory; upon such an hypothesis everybody would become a footpad or a burglar and society would immediately revert to the cave-man period.

Even fear—the first of Mr. Binckley's answers—must be stronger than the last, for if cupidity, lust, desire for possession, or whatever it is to which the "worth while" proposition leads, is paramount, then fear of the consequences must be "paramounter" (forgive the paradox) for comparatively few of us habitually assault our neighbors, or even deliberately defraud them, for gain.

It is my belief, and I believe despite his assertions that it is also Mr. Binckley's, that honor, which covers a sense of justice, of duty, of personal responsibility, even of patriotism, is still the dominant characteristic of human society. I believe—and here Mr. Binckley is with me—that the square deal will attract and hold more desirable men than any other policy. And surely "making it worth his while" is a deal "on the bias" if ever one was, for it inevitably means injustice to the other fellow.

Causing Labor Turnover

Mr. Binckley's theory was given ample tryout during the war period and if I comprehend the system rightly was not the cure but the cause of the most appalling labor turnover our country ever experienced. Every shop was making frantic endeavor to make it "worth the while" of employees of other shops to quit their jobs and come over. They all succeeded; and held their newly acquired men—until the next day.

Were the shops that held the loyalty of their men, that maintained their production, that were immune from labor trouble, the shops that paid the most money? They were not! They were those whose managers best knew real human nature, who gave their employees the "square deal," who even preached "duty" and "patriotism"; who sought and obtained those men who had a sense of honor and personal responsibility.

Did those men who sacrificed their business or gave up positions of prominence and goodly emolument to devote their time and talent to the public welfare do so because it was "worth their while?" Maybe! but what was "worth while" to them can never be measured in dollars and cents.

Did the khaki-clad soldier who went "over the top" to almost certain death in the cold gray light of the morning before do so because he would get thirty-three dollars a month and found—if he was ever found? I don't think.

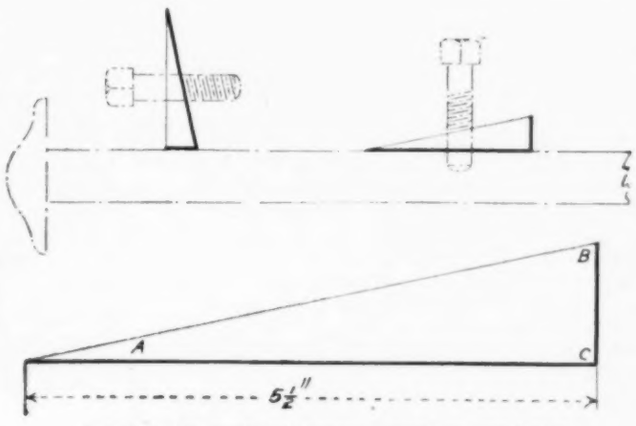
No! Mr. Binckley: you're wrong. Unless "making it worth while" includes an appeal to his sense of duty or his patriotism—which is an appeal to his honor—then your method will never get the "worth while" man. There are, as I intimated before, many human characteristics, and the manager who knows his men will know from their individual temperament upon what button to press to secure the desired results, but the competent manager who wants faithful and efficient service and is willing to render just return for it will never touch the button marked "cupidity."

Drafting Room Kink

By L. Weare

The triangle here shown has been used by the writer to great advantage for threaded work. It may be made of celluloid or other material such as is used for ordinary triangles.

Angle *B* is made 78 deg. and angle *A* 12 deg., causing *C* to maintain a 90-deg. angle.



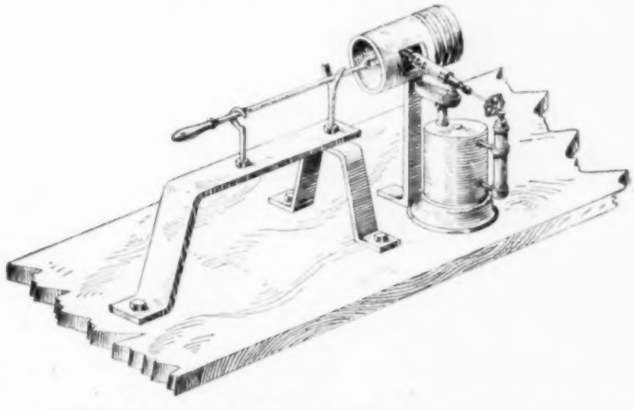
TRIANGLE FOR DRAWING SCREW THREAD

As will be seen the triangle may be used for either horizontal or vertical positioned screw threads. Left-hand screw threads may also be made by merely turning the upward face of triangle next to drawing board. It is apparent that all lines of screw threads may be kept parallel and much time can be saved on work that requires neatness.

Furnace for Heating Soldering Copper

By Charles H. Willey

The accompanying sketch plainly shows how one may construct from an old automobile piston and some flat stock a useful bench furnace in which a soldering copper can be very quickly heated by means of a torch. The



BENCH FURNACE MADE OF OLD PISTON, AND STAND FOR HOLDING COPPER

piston has an opening about 1½ in. square cut on one side where the piston-pin hole originally was, and the hole on the other side is used to bolt the piston to the leg made of ¼ x 1 in. flat stock. The stand for holding the copper needs no explanation.

National Industrial Conference Board Criticizes Public Health Bulletin No. 106

Essentially Unscientific, Not Justified and Misleading, Are the Conclusions Offered by the Board — Plants Studied in Bulletin Not Comparable

"Essentially unscientific and not justified by the data offered," is the conclusion of the National Industrial Conference Board as to United States Public Health Bulletin No. 106, recently issued as an official public document under the auspices of the U. S. Treasury Department. The conference board is publishing its criticism in a special report entitled "Unwarranted Conclusions Regarding the Eight-hour and Ten-hour Workday."

The Board's report makes it clear that it has no predilections for or against a workday of any specific length, but that it considers Public Health Bulletin No. 106 to be misleading, and looks upon its distribution with grave concern.

"Misleading, unwarranted and unscientific conclusions," says the critique, "are always to be deplored, but when such conclusions, carrying the weight of governmental sanction and bearing upon a highly controversial subject, are stated dogmatically and without qualification, they are dangerous."

The public document in question is principally devoted to a "Comparison of an Eight-hour Plant and a Ten-hour Plant," and the conclusions reached in the report are, that "A comparison of the eight-hour and ten-hour system leads to the conclusion that the eight-hour system is the more efficient"—specifically the Government report concludes: "(1) The outstanding feature of the eight-hour system is steady maintenance of output; (2) under the eight-hour system work with almost full power begins and ends approximately on schedule, and lost time is reduced to a minimum; (3) under the ten-hour system artificial limitation of output is widely prevalent, and under the eight-hour system output varies more nearly according to individual capacity, and (4) the importance of fatigue in the causation of accidents is emphasized by the fact that the higher accident risk accompanies the deeper decline of production—in the ten-hour plant as compared with the eight-hour plant."

The conference board's analysis of Public Health Bulletin No. 106 finds that the above conclusions are "essentially unscientific and not justified by the data offered for the following basic reasons: (1) The two plants from which data were obtained are not fairly comparable, and (2) the basis of experience is too small to justify comprehensive conclusions applicable to industry in general."

I. The Plants Studied Are Not Fairly Comparable

The Government report undertakes to compare a thoroughly established and highly efficient manufactory of automobiles running on an eight-hour schedule, with a rapidly expanding munitions plant "characteristic of the mushroom growth of war industries, and operating with a hastily recruited labor force.

On the basis of this astounding comparison, the Government investigators, the board finds, have undertaken to compare the effectiveness of the eight-hour day with the ten-hour day in industry.

In a description of the two plants presented in parallel columns, the board's report vividly reveals the glaring differences that make comparison as to efficiency of their respective work schedules, as such, utterly meaningless. The differences indeed were such as experience has shown to be causes of variation in production. Thus,

(1) The eight-hour plant was slightly reducing its labor force during the year under investigation, while the ten-hour plant was growing from a payroll of 3,600 in 1914 to more than twice that number in 1915 and at the end of 1917 had reached nearly 13,000; (2) the number of women at the eight-hour plant was only about one per cent of the whole, while in the ten-hour plant it was twenty-five per cent of the whole; (3) the minimum wage paid in the eight-hour plant was five dollars for men or women over eighteen, while in the ten-hour plant the piece-rate wage in 1918 was $3.20 per day for men and $2.80 for women; (4) the eight-hour plant was situated in an established industrial community and most of the workers are said to own their homes, while the ten-hour plant was located in a town not prepared to receive so large an influx of population, with resulting insufficiency of housing, lunch rooms, and other means of comfort; (5) the operations studied at the eight-hour plant were the characteristic processes of an automobile factory, to which the personnel were thoroughly accustomed, while the operations studied at the ten-hour plant were the novel ones of making brass fuses for three-inch shells.

In addition to these and many other material differences, the conference board's critique notes that there were also less tangible, but in practical effect no less important differences that render a comparison of the two plants with respect to the relative efficiency of their working schedules scientifically worthless.

II. Data Gathered Too Meager for Broad Conclusions Drawn

Even had the two plants been comparable with respect to the conclusion drawn, the basis of experience was too meager, the board's report finds, to warrant such conclusions as the Government's document presents.

"So complicated is the problem," says the board's report, "with so many collateral factors entering into it, that only by collecting experience from a large number of establishments are conclusions of a broad nature warranted."

Among the collateral factors entering into the problem are such as, disturbance of efficiency by changes in styles, patterns, etc.; changes in materials used; changes in methods of wage payments; quality of workers in a given department, or in a prior process; labor unrest; changes in management or processes; changes in machinery and equipment.

"Even if this investigation," says the report, "had compared an eight-hour schedule with a ten-hour schedule in the same plant the results must, from the nature of the problem, be accepted as tentative only, and under no circumstances could broad conclusions be safely reached as to the general effects of such schedules throughout the industry."

III. Qualifications Admitted in the Text Are Not Made in the Conclusions

Another feature of the Government's document which causes profound concern is, that while many of the insufficiencies of data and generally limited bases of comparison are recognized in the text of the study, the qualifications made in such connections do not appear in the conclusions. These, on the contrary, are stated broadly and without qualifications.

These conclusions, the board finds, have been given wide publicity and accepted at their face value as the results of scientific study bearing the

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official sanction of the Government. Instances are noted in the Board's critique in which the conclusions of the Government's document are quoted with no qualifications and as if they were the final and certain results of scientific investigation.

"There can, therefore," the board finds, "be no question that the difficult problem of industrial readjustment now pressing upon the country will be further complicated by the unqualified and dogmatic phrasing of the conclusions presented in the bulletin. . . . The official sanction behind the publication of these conclusions gives them special prestige in the minds of many people. It is always against public interest for unwarranted and unscientific statements relating to any important problem to be given publicity, whatever the source may be. In these days of industrial unrest it is especially unfortunate if that source is an agency of the Government. Such is the condemnation that can justly be leveled against Public Health Bulletin No. 106."

Industrial Accident Boards and Commissions Meeting

The seventh annual meeting of the International Association of Industrial Accident Boards and Commissions will be held in San Francisco, Cal., on Sept. 20 to 24, 1920, at the Hotel St. Francis.

The meetings each day will be divided into three sessions—morning, afternoon and evening—among which the usual business meetings and election of officers will take place. Round-table discussions on systems of compensation and other varied subjects will be a feature of the meetings and many useful papers will be read on safety methods by prominent men. Hon. William D. Stephens, Governor of California, will make the address of welcome and Senator Hiram Johnson will also speak.

On Sept. 22 there will be visits to nearby hospitals, and on Sept. 23 a trip to Muir woods and Mount Tamalpais.

Automobile Display at Canadian National Exhibition

The automobile show held at the Canadian National Exhibition at Toronto, Canada, on Aug. 28, was the largest ever held there. Two hundred and twenty motor vehicles were displayed; there were fifty-five different makes of passengeer cars and twenty-two different makes of commercial trucks. Prices of passenger cars ranged from $830 to $15,000, and the approximate value of exhibits was $1,500,000.

How To Make Better Use of Existing Railroad Equipment

Freight Traffic Has Outgrown Carrying Capacities of Railroads—Co-operation of Shippers, Receivers and Railroad Employees Urged—Loading More Heavily and Promptly a Big Help

An urgent appeal to manufacturers and business men of the country to join in making better use of existing railroad equipment as a means of providing an immediate improved transportation service was made in an open letter to industrial and commercial organizations today by the Railroad Committee of the Chamber of Commerce of the United States.

"Freight traffic has increased so rapidly in the United States during the past few years that it has completely outgrown the carrying capacity of the railroads," says the committee. "As a result, it is now necessary for the roads to devise a practical plan for increasing their transportation service. This can only be done by making extensive additions of new facilities and equipment, including freight cars, locomotives, yards and track terminals or by making greater use of existing facilities and equipment.

"The railroads cannot carry out the plan first suggested because under present conditions they are unable to obtain a sufficient amount of new capital; nor would it be possible for them to provide new facilities in time to relieve the present emergency even if the capital were available. They must, therefore, rely on making a maximum use of existing facilities and equipment with the co-operation of all of the other interests concerned—the shippers of freight, receivers of freight, and railroad employees.

"You, as shippers and receivers of freight can take a very important part in this movement. You can add 535,000 freight cars to the available car supply by loading your cars more heavily and loading and unloading them promptly. If the railroads were obliged to buy 535,000 new cars at the present price of about $3,000 per car, it would cost them $1,605,000,000 and would cost the public at least 6 per cent of that amount in the form of increased freight rates.

"The average freight car spends its time as follows: 37 per cent of the time in the hands of the shipper or the receiver; 43 per cent moving from the point of loading or unloading to the terminal where it is put into a train or onto a transfer track; 11 per cent in a train moving from one terminal to another; and 9 per cent laid up for repairs. You, as shippers and receivers of freight, can effect a substantial reduction in the 37 per cent; and the railroads can effect an equally substantial reduction in the 43 per cent.

"You can load and unload your cars promptly if you will. As a rule the railroads allow you 48 hours free time to load your cars and 48 hours to unload them before making any charge for demurrage. If you will use only one-half of this time, thus releasing your cars in one day instead of two, and in addition will order according to your loading capacity, restrict your car order to today's program, avoid the duplication of car orders, and avoid the use of cars for storage purposes, you should be able to reduce the time that the average freight car spends in your hands from 37 per cent to 22 per cent of its total time, and thus add 360,000 cars to the available car supply.

"The average freight car makes twenty round trips each year. By reducing the time needed for each trip 15 per cent, you will enable the car to make twenty-three round trips each year. This is equivalent to adding 15 per cent of 2,400,000 or 360,000 cars to the available car supply.

"The average capacity of the freight cars of the country is 41.6 tons. Some commodities, including coal, steel, ore, sand and gravel, can be loaded 10 per cent beyond the marked capacity of the car. Others, including the bulk commodities of various kinds occupy a great deal of space without adding proportionately to the tonnage carried by the railroads. In loading commodities belonging to either of these classes you should disregard the prescribed minimum carload provision for your commodity, and, if possible, load your cars to their maximum capacity.

"In 1919, the average load per loaded car of all commodities on all the railroads of the country as a whole was 27.8 tons—only 67 per cent of capacity. The railroads have now undertaken to attain an average of 30 tons per car. If you will co-operate with them and add an average of 2.2 tons to each carload, you will add nearly 8 per cent of 2,400,000 cars, or 175,000 cars to the available car supply.

"The Association of Railway Executives, representing 95 per cent of the

railroad mileage of the country has unanimously adopted a program for speeding up car movement and increasing car efficiency in which they undertake, with the co-operation of the public, to secure for the country as a whole: An average daily minimum movement of freight cars of not less than 30 miles per day; an average loading of 30 tons per car; reduction of bad-order cars to maximum of 4 per cent of total owned; an early and substantial reduction in the number of locomotives now unfit for service; more effective efforts to bring about the return of cars to the owner roads.

"You can help to reduce the present excessive number of bad order cars. The last monthly report submitted by the carriers shows 7.4 per cent bad-order cars in the United States as against 5.7 per cent at the beginning of Federal control, an increase of 50,000 cars unfit for use and actually out of service. It should ordinarily be possible to keep the number of bad-order cars below 4 per cent of the total number owned and, if that condition could be brought about today, it would result in immediately making effective on the railroads as a whole in the United States more than 75,000 cars that are now out of service because of unfitness to run.

"You can help the railroads to reduce the number of bad-order cars by loading your cars carefully so as to avoid the injuries to the car that frequently result from the shifting of freight in transit."

Spiral Machinery Co. Expanding

The Spiral Machinery Co., St. Louis, Mo., has purchased the East St. Louis (Ill.) plant of the Globe Motor Truck Syndicate for $60,000 and will convert the plant into a factory for manufacturing the "Adams Spiral Plow" and also for construcing several sizes of motor trucks.

Lytle S. Adams, general manager of the company, is the inventor of a special spiral plow to be used in power farming. The plow is adapted for use in all types of soils, especially hard soils, thereby facilitating plowing at any season of the year.

Robert S. Alter on Permanent Group Committee for San Salvador

Robert S. Alter, vice president of the American Tool Works Co. and a member of the Executive Committee Foreign Trade Association of the Chamber of Commerce, was notified yesterday of his appointment as a member of the Permanent Group Committee for San Salvador, appointed to consider means of carrying out the recommendations of the first and second Pan-American financial conferences with special reference to San Salvador. The appointment was made by Secretary of the Treasury D. F. Houston. Mr. Alter has also been appointed vice president of the Mississippi Valley Association for Zone 5.

Bethlehem's New Two-Cycle Fuel-Saving Marine Diesel Engine

Charles M. Schwab, chairman of the Bethlehem Steel Corporation, makes the following announcement:

"It is a great pleasure for me to announce that Bethlehelm Steel Corporation and the Bethlehem Shipbuilding Corporation, Ltd., has perfected a new two-cycle fuel-saving marine Diesel engine, especially designed for American operating conditions and adapted to land use as well as cargo vessels of any size. In the science and practice of marine engineering, this new engine represents a far greater advance over the oil-burning steamship than the latter is over the coal-fired steamship. It is also regarded as a signal triumph for American engineering skill in a field hitherto dominated entirely by Europeans.

"The development of the new Bethlehem fuel-saving Diesel engine represents two distinct phases of advance in marine engineering: (1) For the first time an internal-combustion heavy oil engine for either marine or land uses has been perfected which is not only designed and built by Americans, but is built especially for Americans and is adapted to American operating conditions. (2) For the first time a two-cycle internal-combustion heavy oil engine has been perfecteed which produces the same horsepower as a four-cycle engine practically twice its size, and is at the same time adapted to large cargo ships while saving two-thirds in fuel cost alone, as compared with steam-driven, oil-fired vessels.

"Neither of these developments is theoretically a new idea. For years Europeans have successfully operated large ships with Diesel engines. The achievement of Arthur West, the Bethlehem designer, who is at the head of our power department, is in the adaptation of the two-cycle engine to American operation and in its perfection for practical use in cargo vessels of any size.

"The success of this engine has already been demonstrated in two ways. It was installed and operated for ten months as part of the power plant of the Bethlehem Steel Corporation at Bethlehem, Pa. It was then installed in our new ore-carrying vessel, the "Cubore," which has just completed, on regular schedule time, its first voyage to Cuba and return.

"The operation of the engine at the Bethlehem plant was so successful that we are building another one to take its place as part of the auxiliary power plant for the steel mills. Its operation on the "Cubore" not only demonstrated its practicability but its remarkable economy. The "Cubore" made the voyage from Sparrows Point, Md., to Cuba and back on one-third of the amount of fuel ordinarily consumed by an oil-burning cargo vessel of the same size on the same voyage, and at a better rate of economy than has been achieved by any present type of Diesel engine.

"We also have in service between here and Cuba duplicate ships, except that some are fitted with turbine reduction gears and some with reciprocating engines, so that we have a direct comparison between the oil-engine installation and the most moderen steam installation."

Tenth Annual Convention of the American Railway Tool Foremen's Association

The American Railway Tool Foremen's Association held its tenth annual convention at the Hotel Sherman, Chicago, Ill., on Sept. 1, 2 and 3. The convention opened on Wednesday, Sept. 1, at 10 a.m. An address of welcome was read, followed by an address to railway tool foremen.

The following topics were discussed and reported on by committees at the convention: Standardization of Boiler and Staybolt Taps, Heat Treatment of Steels, Jigs and Devices for Locomotive and Car Shops, Power Punches and Dies, and Issuing and Checking Tools in Locomotive and Car Shops.

The entertainment committee did its work well. On Wednesday evening there was a theater party; on Thursday, 1 p.m., an automobile ride for ladies, and in the evening, the annual banquet followed by dancing; on Friday, the farewell reception.

The officers of the association for 1919-1920 are: J. C. Bevelle, president, El Paso & South Western R.R., El Paso, Tex.; J. B. Hasty, first vice-president, Atchison, Topeka & Santa Fe R.R., San Bernardino, Cal.; G. W. Smith, second vice-president, Chesapeake & Ohio R.R., Huntington, W. Va.; Charles Helm, third vice president, Chicago, Milwaukee & St. Paul R.R., Milwaukee, Wis.; B. Hendrikson, chairman executive committee, Chicago & Northwestern R.R., Chicago, Ill.; R. D. Fletcher, secretary-treasurer, Chicago, Ill.

The officers of the Supply Association are Charles N. Thulin, president, and G. W. Thomson, secretary-treasurer. The supply association's annual meeting was held on Thursday morning.

Navy Yard Machinists Not Pleased with Wage Award

Machinists and skilled mechanics in the various Navy Yards in the country are not at all pleased by the award growing out of the report of the Wage Adjustment Board. While a flat increase of 5 per cent was made in the present scale, the award puts into effect a Saturday half-holiday the year round, without pay, thereby reducing the working time four hours a week.

The machinists asked for 27½ per cent increase. They asked for $1.25 an hour, but under the award they will receive 93½ cents per hour. The weekly pay check of the machinists will be somewhat less, but they gain four hours of leisure time.

The reason given by the Secretary of the Navy for extending the Saturday half-holiday is to equalize the increase, so that it will not be necessary to lay off employees.

Twelve Principles of Industrial Rule Approved

The New York *Tribune* for Aug. 28 prints the following account of a referendum on principles of industrial relations:

A declaration of twelve principles of industrial relations, in which the open shop is advocated, restriction of output to create an artificial scarcity is condemned, arbitration of labor troubles is favored and state control of workers as well as of corporations is urged has been overwhelmingly indorsed by 108 commercial and industrial organizations in New York State.

A referendum on the declaration was taken recently by the Chamber of Commerce of the United States at Washington in every state in the Union, and virtually the entire nation is in accord on the insistence that the twelve principles should be adopted in the intercourse between employer and employee.

The twelve recommendations submitted were as follows:

Every person has the right to engage in any lawful occupation and to enter individually or collectively into any lawful contract of employment, either as employer or employee.

The right of open-shop operation—that is, the right of employer and employee to determine the conditions of employment relations with each other—is an essential part of the individual right of contract possessed by each of the parties.

All men possess the equal right to associate voluntarily for the accomplishment of lawful purposes by lawful means, but such association confers no authority over, and must not deny any right of, those who do not desire to act or deal with them.

Associations or combinations of employers or employees, or both, must be legally responsible for their conduct and that of their agents.

The restriction of productive effort or of output by either employer or employee for the purpose of creating an artificial scarcity of the product or of labor is an injury to society.

The wage of labor must come out of the product of industry and must be earned and measured by its contribution thereto. It is the duty of management to co-operate with the worker to secure continuous employment.

The number of hours in the work day or week in which the maximum output, consistent with the health and well-being of the individual, can be maintained in a given industry should be ascertained by careful study and never should be exceeded except in case of emergency, and one day of rest should be provided. Reduction in working hours below such economic limit, in order to secure greater leisure for the individual, should be made only with understanding and acceptance of the fact that it involves a commensurate loss in the earning power of the workers, a limitation of output and increase in the cost of the product.

Adequate means, satisfactory both to the employer and his employees, and voluntarily agreed to by them, should be provided for discussion and adjustment of employment relations.

When the employer and his employees do not deal individually, but by mutual consent through representatives, representatives should not be chosen or controlled by or represent any outside group or interest.

The greatest measure of reward and well-being for employer and employee and the full social value of their service must be sought in the successful conduct and full development of the particular industrial establishment in which they are associated.

While the right of government employees, to secure just treatment must be amply safeguarded, the community welfare demands that no combination to prevent or impair the operation of government or of any government function shall be permitted.

The power of regulation and protection exercised by the state over the corporation should properly extend to the employees in so far as may be necessary to assure unimpaired operation of public utility service.

American Foundrymen's Association Exhibit Activities

"Bringing Together the Buyers, the Sellers and the Goods," is the title of a circular being sent out by the American Foundrymen's Association. It follows:

"Perhaps you are overlooking an exceptional opportunity to effectively reach an important part of your market. Consider for a moment the great possibilities of actually bringing together your product and your prospects.

"Nothing equals an actual demonstration for convincing sales value.

"No sales opportunity equals that of reaching thoroughly the cream of the buying power of the vast metals manufacturing industries.

"This superior sales method applied to this superior audience of potential buyers is what is available to you in the exhibit space of the 1920 Foundry and Machine Exhibit at Columbus, Ohio, the week of Oct. 4.

"The Annual A. F. A. Foundry and Machine Exhibits have steadily increased in size and importance until the exhibits this year will fill seven large buildings, comprising three acres under roof and surpassing in both size and quality any that have preceded it. All exhibits are grouped systematically according to plans that fifteen years of experience shows to be best.

"The exhibit is not a private enterprise conducted for profit, but is part of the educational and promotional benefits that work hand in hand with the technical research and the other activities of the American Foundrymen's Association. Thousands of "metal" men from every part of the country, and many from foreign lands, annually attend this joint convention and exhibit. It is the one big event of the year in the foundry and allied industries.

Big Chance for Engineers in South America

The Editor of *Ingenieria Internacional*, Verne L. Havens, has just returned to New York after a seven months' visit to Panama, Peru, Chile, Argentina, Brazil and the Windward Islands.

When he sailed from North America last January he believed that the unusual conditions existing in the United States were peculiar, in a general sense, to that country. He knew that every country of the world had serious problems, but thought they would be notably different in different places.

From personal visits with a large number of the readers of *Ingenieria Internacional*, public officers, engineers, bankers and contractors throughout the countries mentioned, and correspondence with many others in other parts of the continent, several fundamental facts have been encountered. In nearly every instance the persons with whom he has talked have believed that the conditions in their country or city were also peculiar to that place, but the reports were always the same.

The people are in a highly nervous state throughout all the Americas. They are groping for new ideals and standards on which to base their lives. This is no doubt due to the excitement and emotions caused by the war and can only be overcome by the leaders teaching peace, co-operation and calmness.

The second great fact in all the Americas, perhaps in all the world, is the actual shortage of labor, and especially of skilled men. The millions of selected men who died in Europe and on every sea, the tens of millions of people who will not work, or cannot work, have created an enormous shortage all over the world.

Why is it that men are scarce in Sao Paulo—because others have died in Europe? Because at one time Europe made cloth and pottery and leather for the Paulistas? To-day the Paulistas make it for themselves, but the persons who make cloth cannot build railways nor plant coffee nor load ships. The establishment of the new industries, small though many of them are, has drawn men from other kinds of labor and they have not been replaced.

The city labor of Buenos Aires has gone to the farms and ranches to replace the Spanish and Italian "golondrinas" or immigrants, who, in turn, have remained in their own country or gone to France. Every country has had to pay the price of the loss of men, generally skillful workers, during the last five years.

The shortage of men and the lack of production during this period has caused prices and wages to increase. In general, it may be said that wages have gone up 50 per cent throughout South America, in some isolated localities the increase has been more or it has been less, but 50 per cent is a fair average. In general the number of working hours has decreased about 20 per cent and no doubt due to the general ner-

vous condition, the production is only about 75 per cent of what it was a few years ago. All this means that in the worst cases, where all these changes have occurred, the cost of production today is about 250 per cent of that of 1913, and there are only two ways to improve this condition. The first will take years; namely, to train the boys to take the place of the men who are gone, or who for any reason have ceased to labor. The second method is one that will help much sooner; machinery must be used wherever possible to reduce the work of the man. Waterpower must be developed and the unnecessary mining, transporting and burning of fuel must be stopped.

The world has always looked to engineers to build the physical elements of that civilization which existed in various epochs, but at no time in the history of the world has the engineer been called upon to face the social, industrial and economic problems as he has today. The work of the engineers of this generation will decide whether we are to progress or retrograde; and perhaps at no time in all the centuries to come will the engineers and industrial executives of Latin-America have the opportunity to build for the future that lies before them today.

Canada and England Opposed to Metric System

Despite the renewal of propaganda work for the adoption of the metric system in English speaking lands, there is little prospect that the system will be substituted for the present system in use in those countries. The Canadian Manufacturers' Association at its last convention resolved to oppose any attempt to substitute the metric system. With such influential bodies as the National Association of Manufacturers, in the United States; the Federation of British Industries, in the United Kingdom, and the Canadian association in the Dominion opposed, there is said to be little chance for the metric system's advocates making headway with their hobby.

Trade Catalogs

Thor Universal Electric Drills. Independent Pneumatic Tool Co., Chicago, Ill. Circular No. 33 giving illustrated descriptions of several new types of Thor portable electric drills. Tables of specifications for drilling with these tools are also included.

Differential Electric Dumping Car. Differential Steel Car Co., Inc., Findlay, Ohio. Bulletins D-4 and D-5, giving descriptions of the various types of steel dumping cars. Photographs of these cars are included to make the bulletins very clear and understandable.

Wire Coil Springs. Reliance Spring and Manufacturing Co., Inc. (formerly Charles A. Cook & Co., Inc.), 3911 Second Ave., Brooklyn, N. Y. Catalog, pp. 20, 3¼ x 6 in. A handy-sized booklet containing complete information on Reliance spring products. The data presented covers wire springs, extensions and expansion springs, torsion springs, flat steel springs and "Samson" exercisers and muscle developers. Tables of decimal and metric equivalents for spring measurements are also included.

Business Items

The Mason Machine Works Co., of Taunton, Mass., has recently been incorporated with a capital stock of $1,000,000, to carry on the manufacture of machinery, etc.

The Foerster and Kaysing Iron Works, St. Louis, Mo., has purchased the 50 x 145-ft. building which it formerly occupied under lease, and will make extensive improvement on its new property. The plant consists of a two-story brick office building and a one-story shop for foundry work.

The Roberts Manufacturing Co., Atlantic City, N. J., will manufacture well points, iron pumps, soil pipe, soil fittings and cast-iron specialties for the plumbing trade. It will be in the market to buy, when ready, special punches and foundry machinery. The company has an option on a large factory building.

The Port Chester Pneumatic Tool Co., Inc., of Greenwich, Conn., has recently been organized to manufacture pneumatic tools, etc.

The Waltham Lathe and Manufacturing Co., of Waltham, Mass., was recently organized and incorporated with a capital of $50,000, to make and deal in lathes and machinery.

Personals

BRENT A. TOZZER, for twelve years Cleveland sales manager for Niles-Bement-Pond, will sail about Oct. 1 for India and the Far East. He expects to be gone about a year in the interests of N. B. P.

P. Z. VERNON, of Alfred Herbert, Ltd., New York, arrived in New York on the "Kaiser Augusta Victoria" on Sept. 9 for a few weeks to familiarize himself at first hand with conditions in the United States.

THOMAS W. PANGBORN, president of the Pangborn Corporation, Hagerstown, Md.; John C. Pangborn, vice president, and W. L. Lytle, general sales engineer, will all attend the American Foundrymen's Association Convention at Columbus, Ohio, on Oct. 4 to 8.

Obituary

CHARLES P. TOMLISON, president of the Belleclair Foundry Co. of Belleville, Ill., died at his home in Belleville on Aug. 28; he was 62 years old. Mr. Tomlison was a native of Philadelphia, Pa., and had been active in Mississippi Valley industrial circles for the past twelve years.

C. HAROLD PUTNAM, assistant treasurer and general manager of the Malleable Iron Works, Baltimore, Md., died recently in the John Hopkins Hospital.

New Publications

Accounts in Theory and Practice—Principles. By Earl A. Saliers. Three hundred and one 6 x 9-in. pages. Bound in light brown cloth boards. Published by the McGraw-Hill Book Co., 239 West 39th St., New York.

This is the first of a two-book series, the second volume being intended to deal with advanced accounts. This book comprises a course in the principles of accounts for the first half year of college work, but as the book presents an effective combination of theoretical discussion and practical application, it will also interest accountants and business men generally. The author is assistant professor of accounting in the Sheffield Scientific School, Yale University. There are six part divisions and a total of 51 chapters. The part headings are: Fundamental Principles, Partnership Accounting, Expansion of Accounting, Records, Corporation Accounting, Financial Statements, Special Applications of Principles.

Vocational Arithmetic. By Clarence E. Paddock, Wentworth Institute, Boston, Mass., and Edward E. Holton, head of the department of machine shop practice, Technical High School, Springfield, Mass. Two hundred and thirty-two 4½ x 7-in. pages. Published by D. Appleton & Co., New York.

A splendid little book which should fill a long-felt demand for a practical arithmetic for the student without an instructor as well as the student in the vocational school and the man in the shop. The subjects are skilfully handled, being presented plainly and logically. All concrete problems involve objects chosen to excite the interest of the vocational student. Chapters worthy of special mention are those on decimals, the use of formulas, mensuration measurements of lumber and toothed wheels. Price $2.00.

Forthcoming Meetings

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The Sixth National Exposition of Chemical Industries will be held in New York on Sept. 20 at the Grand Central Palace.

The Association of Iron and Steel Electrical Engineers will hold its fourteenth annual convention at the Hotel Pennsylvania, New York, Sept. 20 to 24.

The seventh annual meeting of the International Association of Industrial Accident Boards and Commissions will be held in San Francisco, Cal., on Sept. 20 to 24, 1920, at the Hotel St. Francis.

The National Safety Council, 168 North Michigan Ave., Chicago, Ill., will hold its ninth annual safety congress in Milwaukee on Sept. 27 to Oct. 1.

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

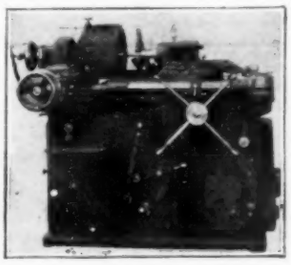
The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Grinding Machine, Internal, "Cincinnati" No. 9
Cincinnati Grinder Co., Cincinnati, Ohio.
"American Machinist," Sept. 2, 1920



The machine is particularly adapted to repetition work in the grinding of either straight or tapered holes in such parts as can be revolved in a chuck or on a faceplate. It consists essentially of a swiveling wheel-head carried upon a table which is provided with longitudinal motion only; a workhead mounted on a cross-slide in such a manner as to provide a transverse movement for adjustment and feeding the work to the wheel; a reverse plate mounted on the front of the base for automatically controling the reversal of the table; a gear box for varying the speed of table; an automatic feeding device for the cross-slide; a gear box for controling the rotative speed of the work; a truing diamond carrier, and a coolant system.

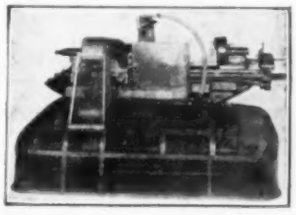
Chamfering Machine, Automatic, Double-Spindle, "Grant."
Grant Manufacturing and Machine Co., 90 Silliman Ave., Bridgeport, Conn.
"American Machinist," Sept. 2, 1920

The machine is intended for chamfering simultaneously both ends of automobile engine piston pins; and it is claimed that a speed of 40 pins per minute with pins ⅞ in. in diameter and 3 in. long, can be maintained. The pins, placed in a hopper at the front of the machine, are automatically placed one at a time in position for machining. The cutters advance and recede automatically, after which the finished pin is ejected down the diagonal slide. The use of the machine is not restricted to chamfering, as it can be applied to drilling, facing or counter-boring opposite sides of small work. The work need not be round in section, as square or irregular shapes can be handled.

Press, Arbor and Broaching, "Hercules," 15-Ton
Hercules Machinery Co., Detroit, Mich.
"American Machinist," Sept. 2, 1920

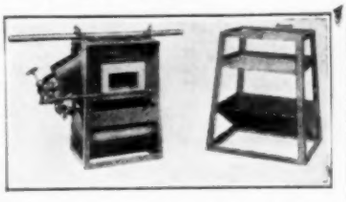
The machine has been redesigned, and it is claimed that the number of operations which it can handle has been increased. The ram has a travel of 18 in. and is driven either by a belt or by an individual motor mounted on the back of the column. The knee has a vertical adjustment of 14 in., being moved by means of a hand lever, and it is removable, so that fixtures or conveyors can be put in its place. The press is guaranteed to have a capacity of 15 tons pressure, each machine being tested up to 18 tons pressure, at which point a pin in the drive will shear in order to prevent breakage of the press. The travel of the ram is governed by means of an automatic trip. Floor space, 6 square feet.

Grinding Machine Guard, "Modern"
Modern Tool Co., Erie, Pa.
"American Machinist," Sept. 2, 1920



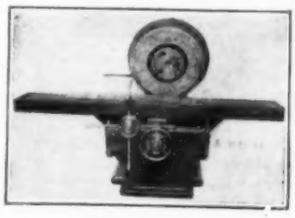
This guard is intended for use on plain cylindrical self-contained grinding machines to replace the cast-iron ones formerly used. It is known as the phantom type and is made of expanded metal riveted to a frame of angle iron. It is supplied as a unit and not in sections, and can be attached without the use of a wrench or screw driver. It is claimed that the guard is light, but sufficiently strong to be a thorough protection to the moving parts which it incloses. The corners are rounded to follow the line of the machine. Practically complete visibility of the inclosed parts is obtained. Hinged portions and hand-holes are provided for the sake of accessibility, so that lubrication and minor adjustments can be attended to without removing the guard.

Forge, Rivet, Hand-Portable, Oil-Fuel, "Mahr," 12-D
Mahr Manufacturing Co., Minneapolis, Minn.
"American Machinist," Sept. 2, 1920



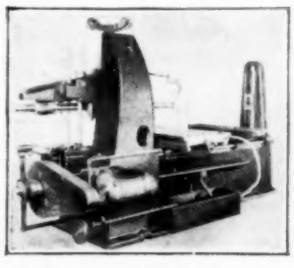
This forge is intended especially for shipyard and scaffold work, and is of all-steel welded construction. It is composed of two units, the upper containing the forge and tank, while the stand is arranged with a long tray and rivet bin and fitted with a clasp so that it can be secured to the forge and moved with it if desired. The forge has a three-piece tile lining. The burner works on the vacuum principle and draws oil directly from the tank below, thus avoiding the necessity of carrying air pressure in the oil tank. It is claimed that the burner will handle even dirty grades of oil without trouble, and that when once adjusted the forge requires but little attention. Tank capacity, 5 gal. Oil consumption, 1¾ gal. per hour. Air consumption, 3 cu.ft. per minute. Height overall on stand, 46½ in. Floor space of stand, 13 x 36 in. Net weight; forge and tank, 165 lb.; stand, 30 lb.

Grinding Machine, Table for Face-Grinding, "Badger"
Badger Tool Co., Beloit, Wis.
"American Machinist," Sept. 2, 1920



This table is intended to be used on the regular line of single-spindle disk and cylinder-wheel grinding machines to hold work while face grinding. The illustration shows the table on a No. 8 machine serving a 20-in. abrasive cylinder held in a chuck. Travel is produced by means of a pilot-wheel operating a gear engaging a rack, the leverage being 10 to 1. By means of a handwheel carrying a dial a feed of 4 in. toward the grinding adjustments can be made by moving the main saddle on the bed. All table and grinding wheel equipments are interchangeable. Complete dust-exhaust or wheel-grinding systems can be supplied. Table; travel, 32 in.; working surface, 10 x 32 in. Net weight of No. 8 size 1,000 lb.

Coolant System, Boring Machine, "Universal"
Universal Boring Machine Co., Hudson, Mass.
"American Machinist," Sept. 2, 1920

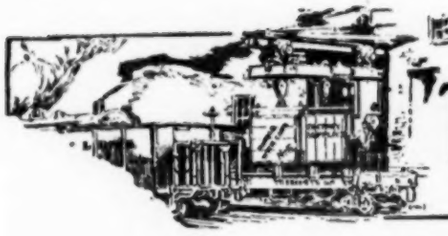


This coolant system can be supplied on machines when ordered. The pump is of the impeller type with a capacity of 12 gal. per minute, being driven by a belt from the motor driving the machine. The intake to the system is ¾ in. in diameter, and no part of the passage is smaller. The coolant is delivered to the cutting tool through a flexible-tube nozzle. The table of the machine is provided with deep pockets and grooves for collecting the coolant, which is delivered to the tank through a flexible tube. Troughs on the front, rear and between the ways of the bed serve to collect and carry off the lubricant which falls from the table.

Drilling Machine, Upright, "Silver," 20-Inch
Silver Manufacturing Co., Salem, Ohio.
"American Machinist," Sept. 2, 1920

This machine has been redesigned, the principal changes being in the style of the frame and an increase in capacity under the spindle. It is intended as a general purpose tool. The spindle is provided with an S.K.F. ball thrust bearing. The machine can be supplied with either hand or power feed, and with a tapping attachment if desired. It can be furnished with either geared or belted motor drive and in gangs of either two, three or four spindles. Height, 75 in. Travel of spindle, 12 in. Travel of table, 17½ in. Spindle to base; maximum, 42⅜ in. Spindle to table; maximum, 28½ in. Weight; net, 775 lb.; shipping, 860 lb.; boxed for export, 1,050 lb. Volume, boxed, 23 cu.ft.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$45.60	$29.80
Northern Basic	51.30	27.55
Southern Ohio No. 2	47.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	54.30	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25–2.75 sil.	50.00	30.65
Virginia No. 2	50.00*	30.85
Basic	48.00†	29.90
Grey Forge	45.00*	29.90
CHICAGO		
No. 2 Foundry local	46.40	27.25
No. 2 Foundry, Southern	48.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	49.00	28.15
Basic	48.50	27.15
Bessemer	50.00	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.58	$3.97	$3.47	$5.00	$3.37	$3.97	$3.47
Soft steel bars	4.73	4.12	3.37	4.50	3.27	3.87	3.37
Soft steel bar shapes	4.73	4.12	3.37	...	3.27	3.87	3.37
Soft steel bands	6.43	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.78	4.17	3.67	4.50	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.62
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55–7.00	7.23@8.00	4.57	8.10	7.02
No. 12	3.60–7.05	7.28@8.05	4.57	8.15	7.07
No. 14	3.65–7.10	7.33@8.10	.67	8.20	7.12
No. 16	3.75–7.20	7.43@8.20	4.77	8.30	7.22
Black					
Nos. 18 and 20	4.20–6.20	8.41@9.80	5.30	8.70	7.80
Nos. 22 and 24	4.25–6.25	8.46@9.85	5.35	8.75	7.85
No. 26	4.30–6.30	8.51@9.90	5.40	8.80	7.90
No. 28	4.35–6.35	8.61@10.00	5.50	8.90	8.00
Galvanized					
No. 10	4.70–8.00	8.91@11.50	6.20	9.00	8.15
No. 12	4.80–8.10	9.01@11.50	6.25	9.10	8.20
No. 14	4.80–8.10	9.01@11.60	6.30	9.10	8.35
Nos. 18 and 20	5.10–8.40	9.26@11.90	6.60	9.40	8.65
Nos. 22 and 24	5.25–8.55	9.41@12.05	6.75	9.55	9.05
No. 26	5.40–8.70	9.56@12.20	6.90	9.70	9.20
No. 28	5.70–9.00	9.86@12.50	7.20	10.00	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.36	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.86	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL—Base prices in cents per pound F.O.B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	40
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55

Special Nickel and Alloys	
Malleable nickel ingots	42
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, grades "A" and "C" (base)	72
Copper nickel ingots	45
Hot rolled copper nickel rods (base)	54
Manganese nickel hot rolled (base) rods "D"—low manganese	62
Manganese nickel hot rolled (base) rods "D"—high manganese	67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f.o.b. New York: 5/32, 8½c. per lb.; ⅛, 8c.; 5/16 to ½, 7¼c Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	7.50
Hoop steel	6.68	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.91

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
¼ to 3	45–57½%	41½–44%	⅛	15½–25½%	+1½–11½%
			¼	19½–29½%	1½–11½%
			⅜ to 1½	24½–34½%	8 –18½%

LAP WELD

2	47 –50½%	34½–38%	1¼		
2½ to 6	50 –53½%	37½–41%	1½		
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %		2½ to 6	22½–30½%	9½–17½%
15	35 –38½%		2½ to 4	22½–30½%	9½–17½%
			7 to 12	19½–27½%	6½–14½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

¼ to 1½	52 –55½%	39½–43%	⅛ to 1½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45 –48½%	33½–37%	1¼		
2½ to 4	48 –51½%	36½–40%	1½		
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅛ to 3 in. steel butt welded	38%	22%	39%	30%	54%@40%	40½@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50%@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	18.62	19.25	21.75
Tin in 5-ton lots	46.50	61.50	70.00
Lead	9.00	9.00	5.50
Zinc	8.50	8.70	8.00
ST. LOUIS			
Lead	9.00	8.87½	5.25
Zinc	7.70@8.05	8.37½	7.65

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

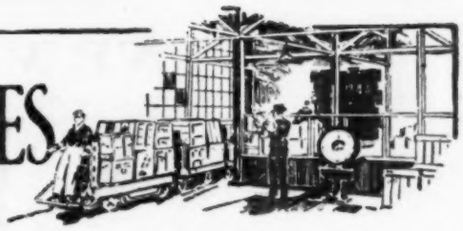
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	33.50	33.50	29.50	34.00	33.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	26.50	29.00	29.50	29.00	25.00
Brass sheets	28.50	28.50	23.00	36.00	29.00	27.00	28.00
Brass pipe	33.00	33.00	34.00	34.00	36.00	34.00	37.00
Solder (half and half) (case lots)	38.00	33.00	45.00	40.50	41.00	38.00	41.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	19.00
New York	27.00	21.50
Cleveland	27.00	30.00
Chicago	30.00	30.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound are f.o.b. mill + less 8% for carload lots..... 12.50

	Warehouse			
	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	12.50	15.50	13.00
New York	14.00	11.50	14.50	12.50
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.12	9.50
Chicago	9.00	9.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	15.00	17.00	14.50	15.00
Copper, heavy, and wire	14.00	16.00	14.00	14.50
Copper, light, and bottoms	12.50	14.00	12.50	13.00
Lead, heavy	7.00	4.75	7.00	7.00
Lead, tea	5.00	3.75	4.00	6.00
Brass, heavy	9.50	10.50	10.50	14.50
Brass, light	7.00	7.50	7.50	8.00
No. 1 yellow brass turnings	8.50	10.00	8.00	8.00
Zinc	5.00	5.00	4.50	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$33.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	33.00
Chicago	29.00	31.00
Cleveland	34.00	35.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	57.00	70.00	60.00	60.00
Commercial	50.00	50.50	21.00	16.50	15.00	13.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	—New York—		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$1.50	List net	$2.25	List	1.85
Hot pressed hexagon	+ 6.00	1.50	List net	2.25	List	1.85
Cold punched hexagon	+ 6.00	1.50	List net	2.25	List	1.30
Cold punched square	+ 6.00	1.50	List net	2.25	List	1.30

Semi-finished nuts, ⅝ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50-10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
¾ by 4 in. and smaller	+ 20%	25%	20%
Larger and longer up to 1¼ in. by 30 in.	+ 20%	25%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... list Cleveland..... $2.00 Chicago..... $3.00

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
¾ by 6 in. and smaller	+ 20%	25%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ½, ⅝, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..... $6.00 Chicago..... $5.62 Pittsburgh..... $4.5

Structural, same sizes:
New York..... $7.10 Chicago..... $5.72 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb lots is as follows:

	New York	Cleveland	Chicago
Copper	$34.00	$36.00	$35.00
Brass	33.00	36.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add 15-20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ½-2 in. inclusive in rounds, and ½-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

In Cleveland—$[illegible] per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
White	15.00@17.00	13.00	16.00	14.00 to 14.00
Colored mixed	9.00@14.00	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$3.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	2.50	2.75
Chicago	2.00	2.50	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	September 13	September 6	August 30
Prompt furnace	$17.00@$18.00	$17.00@$18.00	$17.00@$18.00
Prompt foundry	18.00@20.00	18.00@20.00	18.00@20.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

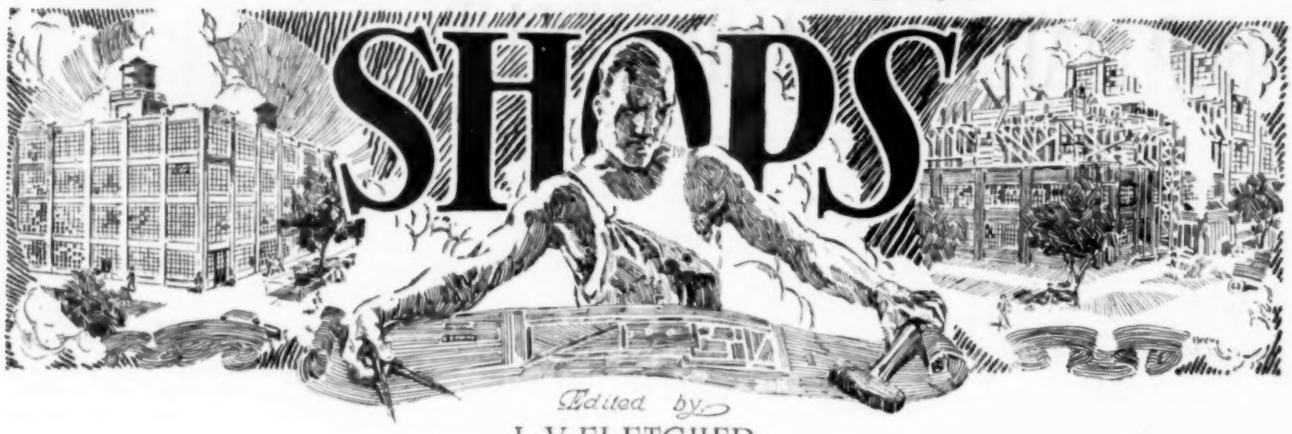
	—New York—		—Cleveland—		—Chicago—	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots	$1.25	$2.15	$1.86	$2.50	$1.22	$2.37
5-gal cans	1.40	2.30	2.15	2.75	1.47	2.52
1-gal cans (6 to case)	1.45	.....	.....	.....	.....	.....

WHITE AND RED LEAD—Base price per pound:

	— Red —				— White —	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW *and* ENLARGED



Edited by
L·V·FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Mass., Worcester—The Amer. Steel and Wire Co., Grove St.—one open side planer.

N. J., Jersey City—The Safety Car Heating and Lighting Co., 206 Erie St.—miscellaneous machine tools.

N. J., Richmond Hill—R. Schultze, 1070 97th Ave.—one small screw cutting lathe.

N. Y., New York (Borough of Manhattan)—R. L. Fuller & Co., 81 Fulton St.—complete machine shop equipment for export to South America.

N. Y., New York (Borough of Manhattan)—Gibbs & Co., 61 Bway.—one gear planer, capacity up to 6 ft. in diameter, for export to Australia.

N. Y., New York (Borough of Manhattan)—J. Victori & Co., 163 Pearl St.—lathes, milling machines, planers, drills, threading machines and grinding machines for export.

N. Y., Buffalo—The Poll Eells Airplane & Motor Corp., Watson and Clinton Sts.—machine tool equipment for manufacturing steel airplanes.

N. Y., Buffalo — The Sterns Electric Equipment Co., 66-70 Bway.—one 18 or 20 in. shaper.

N. Y., Schenectady—The General Electric Co., River Rd.—one 6 spindle ball bearing sensitive gang drill.

Pa., Philadelphia — The Bd. of Survey, Appraisal and Sale, Navy Yard—76 lathes of various descriptions.

Pa., Pittsburgh — The Pittsburgh Casting and Heater Co., Arrott Power Bldg.—machine tool equipment for gas appliance factory.

La., New Orleans—A. H. Heissler, 2221 St. Peter St.—cylinder boring machines, portable crane of 1,000 lbs. capacity, small drill presses and automobile repair shop equipment. Manufacturers catalogs wanted covering repair shops.

La., New Orleans — The Nelson, Moran Motor Co., Inc., 1700-02 Tulane Ave.—complete garage and service station equipment, including one electric drill.

Va., Richmond—T. O. Critz, 731 Brooke Ave. — milling machine, light lathe and Ford speed equipment.

Va., Richmond—The R. R. Crosby Electric Co., 1705 East Broad St., R. R. Crosby, Purch. Agt.—one lathe 16 to 18 in. swing, 6 ft. bed (used or new), veneering rotary machine and armature winder.

Va., Richmond — The Fleming Welding Shop, 305 North Munford St., A. I. Fleming, Purch. Agt.—lathe, 18 in. swing 6 ft. bed (new or used), and drill press.

Va., Richmond — Kindlers Sheet Metal Shop, 407 Brooks Ave., J. N. Kindler, Purch. Agt.—tinner's and sheet metal tools.

Va., Richmond—The Lee Motor Co., 1707 East Broad St., E. J. Hewitt, Purch. Agt.—small lathe, motor stand, drill press and buffing outfit (new or used).

Va., Richmond — The Richmond Auto Shop, 40 North 18th St., J. B. Cuilingworth, Purch. Agt. — several lathes of various types.

Va., Richmond—Weiler Bros., 624 Brooke Ave.—drill press, small lathe, motor and buffing machine.

Va., Richmond—Williams & Smith, 416 Brooke Ave.—set of combination stock and dies.

Ill., Chicago—The Atchison, Topeka and Santa Fe Ry., Ry. Exch. Bldg., M. J. Collins, Purch. Agt.—

One 48 in. heavy duty car wheel boring machine, 440 v., 3 ph., 60 cy., motor drive.

One high power vertical drill press, capacity 24 in., to drill 4 in. in steel belt drive through gear box; similar press, 440 v., 3 ph., 60 cy., motor drive.

One 42 or 50 in. woodworking band saw complete with blades, brazing attachment and countershaft.

One 16 in. x 6 ft. portable bolt lathe, quick change gears, taper attachment, 440 v., 3 ph., 60 cy., motor drive, all mounted on a truck.

One 16 in. x 6 ft. portable bolt lathe, quick change gears, taper attachment, 220 v., d.c., motor drive, all mounted on a truck.

One 54 in. heavy duty vertical boring mill with 2 blades on rail, belt drive through gear box.

Additional boring mill, 440 v., 3 ph., 60 cy., motor drive.

One planing machine, Amer. No. 77, planer and matcher or similar model 5, size 15 in. x 6 in. with 4 heads completely equipped.

Ill., Chicago—The Athey Tractor Co., 17 North La Salle St.—one horizontal drill with 2 spindles (new or used), each to carry two 1¼ in. and one 1¾ in. drills.

Ill., Chicago — The Chicago and Northwestern Ry., Jackson Blvd. and Franklin St.—F. J. Berck, Purch. Agt.—

One 53 in. double head boring and turning mill, 440 v., 3 ph., 60 cy., motor drive.

One 160 lb. Bradley or equal cushioned upright power hammer, safe and cutting-off machine to cut 2¾ in., 16 in. long, McGrath or equal; 440 v., 3 ph., 60 cy., motor drive.

One combination hot saw and tube expansion machine, Ryerson or equal.

One floor emery grinder, equal to safety E. W. Co. No. 22, 440 v., 3 ph., 60 cy., motor drive.

Two 16 in. x 6 ft. engine lathe with countershaft and 14 in., 4 jaw combination chuck, 440 v., 3 ph., 60 cy., motor drive.

One 16 in. x 4 ft. engine lathe, 220 v., d.c., motor drive.

One Elliptic spring forming machine similar to Ryerson Universal, Bulletin No. 20145.

One pipe threading machine with dies from 1¼ to 6 in., No. 6 Begnal and Kellar or equal, 220 v., d.c., motor drive.

Six portable crank pin turning machines, capacity up to 18 in. length, 12 in. diameter, Underwood No. 2 or equal.

One 24 in. drill press, belt drive.

Two 18 in. x 8 ft. 6 in. engine lathes with 4 jaw combination chuck, 220 v., d.c., motor drive.

One 14 in. emery grinder, 440 v., 3 ph., 60 cy., motor drive.

One 24 in. x 10 ft. engine lathe, belt drive.

Two 16 in. x 8 ft. engine lathes with 14 in. independent chuck, belt drive.

One pipe threading machine, No. 304, Oster or equal, belt drive.

One 30 in. x 8 ft. 6 in. engine lathe with 24 in., 4 jaw independent chuck, belt drive.

One 36 in. drill press, belt drive.

One combination punch and shear, capacity 1 in. hole in ½ in. plate and to shear ¾ in. plate, throat 36 in., 440 v., 3 ph., 60 cy., motor drive.

One 16 in. x 8 ft. engine lathe with 12 in. independent chuck, 440 v., 3 ph., 60 cy., motor drive.

One 24 in. x 14 ft. engine lathe, 440 v., 3 ph., 60 cy., motor drive.

Two 16 in. x 8 ft. engine lathes with 14 in. independent chuck, 440 v., 3 ph., 60 cy., motor drive.

Two hand power lathes, Paxton Mitchell Co., or equal.

One 24 in. x 12 ft. engine lathe with 4 jaw combination chuck, 440 v., 3 ph., 60 cy., motor drive.

One 18 in. x 8 ft. engine lathe with taper attachment and 15 in., 4 jaw combination chuck, belt drive.

One portable valve seat rotary planing machine, 26 in., Underwood or equal.

One 36 in. Landis or equal grinder with 8 in. chuck, 440 v., 3 ph., 60 cy., motor drive.

One 18 in. x 6 ft. engine lathe, 4 jaw combination chuck, drive not specified.

One single head bolt cutter with countershaft and dies from 1½ to 4½ in., Acme or equal.

One 30 in. crank planer, belt drive.

One 800 lb. steam hammer.

One 30 in. x 6 ft. engine lathe with 24 in., 4 jaw independent chuck, no drive specified.

One 50 ton forcing press, 23 in. between rods, 20 in. under arms and 6 ft. bed, Lucas or equal, 440 v., 3 ph., 60 cy., motor drive.

One 14 in. x 6 ft. engine lathe, 220 v., d.c., motor drive.

In all cases where motors are specified, only Westinghouse, General Electric or Allis-Chalmers will be considered; all motors to be equipped with starter, overload relay and no voltage release.

Tools to be distributed among the following points: Winona, Mason City, Chicago Shops, Proviso, West Chicago, Chicago Ave. Shops, Chase Yard, Janesville, Chadron, Long Pine, Casper, North Fond du Lac, Green Bay, Sheboygan, Manitowoc, Kaukawna, Ashland, Antigo, Oconto, East Clinton, Clinton, Benald, South Pekin, Hawardin, Missouri Valley, South Norfolk, Boone and Council Bluffs.

Ill., Dixon—The Reynolds Wire Co.—one bolt cutter and pipe threader.

Mich., Detroit—The Dept. of Parks and Blvds., Farwell Bldg., E. G. Heckel, Comr.—one tenoning machine and one mortiser (new).

O., Cleveland—The Cloyes Gear Co., 7007 Quincy Ave.—tool room equipment.

O., Cleveland — The E. F. Hauserman Co., 1729 East 22d St.—multiple splitting shear, to take 12 to 20 gage material, 1½ in. to 7 in. wide out of 24 in. sheets or wider.

O., Cleveland—The Potter Acme Mfg. Co., 920 Champlain Ave. — one 21 Bliss press or equivalent.

O., Columbus—The Marvel Tractor Co., Dispatch Annex Bldg.—lathes, drill presses, punches, shapers, cutters, grinders, slotters and threading machines.

Wis., Kewaskum—The Kewaskum Aluminum Co.—punch press.

Wis., Milwaukee—M. J. Walsh Co., 141 Sycamore St.—spot welder to handle ¼ in. stock.
2 in. pipe machine.
4 spindle Sipp or Avery drill.
No. 3 Brown and Sharpe universal miller.
24 in. Gleason planer.
6 in. Bilgran gear generator.
Universal woodworker.
42 in. Bullard or Colburn boring mill.
2½ in. milling machine.
No. 3 Kempsmith plain and universal miller.
24 in. shaper.
30 ton arbor press.
48" x 48" x 10 ft. or 12 ft. planer.
30" x 30" x 8 ft., 10 ft. or 12 ft. planer.

Wis., Sheboygan—The South Side Garage Co., South 12th and Indiana Sts.—lathes, presses, drills, etc.

Wis., West Allis—The Milwaukee Chaplet Co., 299 64th Ave., O. L. Hollister, Purch. Agt.—machine tools for manufacturing stampings and chaplets.

Minn., Minneapolis — The Surgical Supply Co., 5207 Penn. Ave. S., B. W. Scallen, Purch. Agt. — punch press, capacity to punch ½ in. hole through steel ½ in. thick, (used).

Tex., Vernon—W. D. Smithson—14 to 20 in. shapers and 20 in. or 24 in. swing lathe (new or used).

Machinery Wanted

N. J., Woodlynne (Camden P. O.)—The Camden Ice Co., c/o B. H. Lackey, Archt., 509 Federal St., Camden—ice manufacturing machinery.

N. Y., New York (Borough of Manhattan)—The Utah Copper Co., 25 Bway.—one 60 ton overhead traveling crane.

Pa., Philadelphia — The T. Yeardesley Electric Co., 224 North 3d St.—two drums 7 x 9 ft. capacity for 30,000 ft. rope.

La., New Orleans—J. Materus, 637 Royal St.—shoe repairing machinery.

La., New Orleans — The New Orleans Cigar Box Co., 439 South Peters St.—machines for veneering lumber and saws for cutting lumber.

La., New Orleans — The New Orleans Furniture Mfg. Co., Front and Bellecastle Sts.—woodturning lathes, shaper, drill and Barnes drilling machines for furniture manufacturing.

Ill., Chicago — The Borden Condensed Milk Co., 136 West Lake St.—can making and filling machinery for new factory in New London, Wis.

O., Cambridge — The Cambridge Glass Co.—glass-making machinery.

O., Columbus—The Columbus Consumers' Supply Co., 315 North 4th St., R. M. Miller, Purch. Agt.—unloading crane and tipple equipment for handling building material.

Wis., Jefferson—D. Rees—artificial ice-making machinery.

Wis., Milwaukee — Heil Co., 26th and Montana Aves., J. Heil, Purch. Agt.—two 10 ton cranes.

Wis., Muscoda — Muscoda Mfg. Co. — woodworking machinery.

Wis., Oconto Falls — Wisconsin Service Co., T. A. Pamperin, Purch. Agt. — one power crane.

Wis., Park Falls—The Park Falls Lumber Co.—lath mill machinery.

Tex., Dublin—The Keystone Refining Co. —complete equipment for modern refinery.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—The General Electric Co., Boston Ave., will build a 1 story, 40 x 50 ft. factory on Bond St., for the manufacture of small motors. Estimated cost, $15,000.

Conn., Bridgeport — Schwarz Bros., 95 River St., has awarded the contract for the construction of a 1 story, 50 x 85 ft. garage. Estimated cost, $25,000. Noted Sept. 9.

Conn., Bridgeport—The Underwood Typewriter Mfg. Co., 581 Capitol Ave., Hartford, has awarded the contract for altering the old Bullard Machine Co. plant on Broad St. and Railroad Ave., here, and will equip same for its own use. Estimated cost, $25,000.

Conn., Bristol—The Bristol and Plainville Tramway Co., 17 Riverside Ave., has awarded the contract for the construction of a 1 story, 42 x 100 ft. addition to its shops. Estimated cost, $15,000.

Conn., New Britain—The Swift & Upson Lumber Co., 153 Elm St., will build a 1 story, 30 x 50 ft. garage. Estimated cost, $10,000. Noted Aug. 26.

Conn., New Haven — The Safety Car Heating & Lighting Co., Dixwell Ave., manufacturer of car appliances, etc., has awarded the contract for altering its present plant and constructing a 1 story addition. Cost between $25,000 and $35,000.

Conn., Seymour—The Seymour Mfg. Co., 87 Franklin St., has awarded the contract for altering and building a 1 story addition to its foundry. Estimated cost, $25,000.

Conn., Stratford—The Liberty Mfg. Co., 166 Elm St., Bridgeport, has awarded the contract for the construction of a 1 story factory for the manufacture of air cooled motors, here. Estimated cost, $100,000.

Conn., Stratford—H. J. Strauss, 1642 Elm St., will build a 1 story, 35 x 55 ft. garage on Beardsley Ave. Estimated cost, $10,000.

Mass., Dorchester — The Byrne Realty Co., 435 Geneva Ave., will build a 1 story, 95 x 165 ft. addition to its garage on Holmes Ave. Estimated cost, $50,000. Noted July 29.

Mass., Greenfield—The Greenfield Tap and Die Corp., Sanderson St., has awarded the contract for the construction of a 5 story, 60 x 210 ft. addition to its plant. Estimated cost, $250,000. Noted Aug. 19.

Mass., Harwich—The Standard Oil Co. of New York, 50 Congress St., Boston, has awarded the contract for the construction of a 1 story, oil plant here. Estimated cost, $30,000.

Mass., Turners Falls—The Greenfield Tap and Die Corp., Sanderson St., Greenfield, has awarded the contract for the construction of a 1 story, 50 x 100 ft. and 25 x 41 ft. addition to its forge plant here. Estimated cost, $50,000. Noted Aug. 19.

Mass., Wakefield—The Heywood Bros. and Wakefield Co., 206 Central St., Gardner, manufacturer of chains, etc., has awarded the contract for the construction of a 1 story addition to its factory, here. Estimated cost, $75,000. Noted Aug. 12.

Mass., West Springfield—The C. H. Smith Co., 43 Lyman St., has awarded the contract for the construction of a 1 story, 39 x 85 ft. factory on Sylvan St., for the manufacture of cylinder molds, etc. Estimated cost, $10,000.

Mass., Worcester—T. Hanson, 873 Main St. will soon award the contract for the construction of a 2 story, 90 x 90 ft. garage. Estimated cost, $75,000. Noted June 3.

R. I., Pawtucket—Lincoln, Andrews & Lane, plan to build a 1 story, plumbing and tinning plant on Pawtucket Ave. and Sterling St. Estimated cost, $20,000.

R. I., Providence—The National Collapsible Tube Co., 362 Carpenter St., will build a 1 story, 50 x 75 ft. factory. Estimated cost, $12,000.

Vt., Hartford—The Commercial Livery Garage Co., White River Junction, has awarded the contract for the construction of a 1 story, 50 x 150 ft. garage and service station on Maple St., here. T. Wilfore, Prop. Estimated cost, $30,000.

MIDDLE ATLANTIC STATES

N. J., Newark—Griffin & Tyman, Union Bldg., have awarded the contract for the construction of a 1 story, 50 x 200 ft. garage on 37th St. Estimated cost, $15,000.

N. J., Trenton—C. Kline, 228 Cummings Ave., has awarded the contract for the construction of a 1 story, 40 x 101 ft. garage on South Broad St. Estimated cost, $13,000.

N. Y., New York (Borough of Brooklyn) —The Butler Realty Co., C/o Shampan & Shampan, Archts., 50 Court St., will build a 1 story, 100 x 175 ft. garage on Butler and 3rd Aves.

N. Y., New York (Borough of Brooklyn) —C. H. Noble, c/o Springsteen & Goldhammer, Archts., 32 Union Sq., New York City, will build a 3 story, 100 x 110 ft. garage, on South 8th St. Estimated cost, $50,000.

N. Y., New York (Borough of Manhattan)—The Benenson Realty Co., 3rd Ave. and 148th St., will build a 2 story, 100 x 150 ft. garage on Concord Ave. Estimated cost, $45,000.

N. Y., Buffalo—The Buffalo Machine Key Co., 134 Clyde St., has awarded the contract for the construction of a 14 x 36 x 66 ft. factory at 214 Clyde St. Etimated cost, $5,000.

N. Y., Buffalo—Hayman & Co., 856 East Ferry St., has had plans prepared for the construction of a 1 story, 30 x 88 ft. addition to its steel foundry on East Ferry St. and New York Central R.R. Estimated cost, $2,500.

N. Y., Buffalo—Oppenheimer & Co., 140 Efner St., has awarded the contract for converting a 5 story, 60 x 230 ft. building at 13 Perry St., into metal goods factory. Estimated cost, $15,000.

N. Y., Long Island City—The Waverly Bldg. Corp., 44 Court St., Brooklyn, will build a 1 story, 75 x 120 ft. garage on South Wahington Pl. and Jackson Ave., here.

N. Y., Yonkers—The Hudson Tire and Rubber Co. is having plans prepared for the construction of a 3 story factory and power plant. Estimated cost, $300,000. The Osborn Eng. Co., 2848 Prospect Ave., Cleveland, O., Engrs. and Archts.

SOUTHERN STATES

La., New Orleans—The Nelson, Moran Motor Co., 1700-02 Tulane Ave., plans to build a garage. Estimated cost, $20,000.

Tenn., Chattanooga—The Cole Eng. Co. of Philadelphia, plans to move their steel mills here; a factory site for the manufacture of lubricating steel has been purchased.

MIDDLE WEST STATES

Ill., Chicago—J. H. Mosack, c/o D. E. Hannan, Archt., 155 North Clark St., has awarded the contract for the construction of a 1 story, 50 x 100 ft. garage and salesroom addition at 4739 Cottage Grove Ave. Estimated cost, $12,000.

Ill., Chicago — D. Optner, 1106 Austin Ave., Oak Park, will soon award the contract for the construction of a 1 story, 25 x 150 ft. garage, at 18 West Chicago Ave. Estimated cost, $12,000. D. E. Hanna, 155 North Clark St., Archt.

Mich., Detroit—The Dept. Pub. Works, City Hall, has awarded the contract for the construction of a 1 story, 70 x 180 ft. garage at foot of 14th St.

Mich., Detroit—The Modern Sales & Service Co., 33 Woodward Ave., plans to construct a 1 story, 110 x 425 ft. auto service building on Jefferson Ave. and DuBois St. Estimated cost, $200,000.

Mich., Ludington—The Stearns Motor Mfg. Co. is building an 80 x 150 ft. factory for the manufacture of automotive castings. Estimated cost, $50,000.

O., Cleveland—The Atlantic Fdry. Co., East 75th St. and Morgan Ave., has awarded the contract for the construction of a 1 story, 21 x 100 ft. addition to its foundry. Estimated cost, $10,000.

O., Cleveland—The Natl. Lamp Co. of the General Electric Co., Nela Park, plans to build a 3 story factory on Alonzo Ave. near Aetna Rd. Estimated cost, $300,000. G. H. Johnson, Nela Park, East Cleveland, Archt.

O., Cleveland — The Spohn Heating & Ventilating Co., 1775 East 45th St., plans to build a 2 story factory and warehouse on East 46th St. near Hough Ave. Estimated cost, $50,000. G. Nachman, Pres.

O., Cleveland—The Window Tool Co., 1565 East 17th St., plans to build a 1 story, 46 x 130 ft. addition to its factory. Estimated cost, $50,000. E. Windham, Pres.

O., Springfield — The Hoppes Mfg. Co., Belmont Ave., manufacturer of water purifiers, has awarded the contract for the construction of a 2 story, 43 x 78 ft. addition to its factory. Estimated cost, $15,000.

O., Toledo—The Acklin Stamping Co., 1645-53 Dorr St., has increased its capital stock from $50,000 to $500,000 and is having plans prepared by Langdon & Hohly, Archts., for the construction of a plant on Nebraska Ave., east of the Toledo University Farm. Plans include a warehouse with a capacity of 50,000 tons of steel, punch press departments, annealing furnaces, nickel plating and galvanizing plants, electric welding and tool departments.

Wis., Milwaukee—The Krueger Motor Car Co., 485 Jefferson St., has awarded the contract for the construction of a 1 story, 40 x 120 ft. garage. Estimated cost, $30,000. Noted July 8.

Wis., Milwaukee—The Milwaukee Box Toe Co., 140 Reed St., has awarded the contract for the construction of a 2 story, 50 x 100 ft. factory on Fond du Lac Ave. Estimated cost, $40,000. Noted Sept. 9.

Wis., Sheboygan—The South Side Garage Co., South 12th St., and Indiana Ave., is having plans prepared for the construction of a 2 or 3 story, 50 x 150 ft. garage. Estimated cost, $100,000.

WEST OF MISSISSIPPI

Colo., Denver—The Concrete Steel Co., 42 Bway., New York City, will build a 1 story 200 x 200 ft. steel fabricatng shop, here. Estimated cost, $200,000.

Mo., St. Louis—The Schlueter Mfg. Co., Bway. and John St., manufacturer of tinware, has awarded the contract for the construction of a 4 story, 43 x 100 ft. factory. Estimated cost, $55,000.

CANADA

N. S., Glasgow—The Maritime Bridge Co. plans to construct the main building of its plant, which was destroyed by fire.

Ont., Toronto—Peckovers Ltd., Market St., is having plans prepared for the construction of a 2 story, 40 x 60 ft. factory for reinforcing steel. Estimated cost, $35,000.

Que., Montreal—The Magnolia Metal Co., 120 St. James St., has awarded the contract for the construction of a 1 story, 48 x 75 ft. factory. Estimated cost, $17,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Hartford—The Peoples Dairy Co., 50 Dean St., will soon award the contract for the construction of a 1 story, 33 x 60 ft. dairy plant. Estimated cost, $12,000. Berenson & Moses, 1026 Main St., Archts.

Mass., Fall River—The Amer. Printing Co., 56 Water St., will build a power plant, also 1 story, 44 x 133 ft. and 1 story, 100 x 119 ft. factory with 2 ells. Estimated cost, $165,000. Noted Aug. 26.

Mass., Fall River—The New England Oil Corp. has awarded the contract for the construction of an oil storage plant, etc. Estimated cost, $5,000,000.

Mass., Falmouth—The Standard Oil Co. of New York, 50 Congress St., Boston, has awarded the contract for the construction of a 1 and 2 story oil plant here. Estimated cost, $30,000.

Mass., Hyannis—The Standard Oil Co. of New York, 50 Congress St., Boston, has awarded the contract for the construction of a 1 story oil plant here. Estimated cost, $35,000.

Mass., Ware—The Ware Coated Paper Co., South St., has awarded the contract for the construction of a 1 story, 70 x 100 ft. factory on Cummings St. Estimated cost, $40,000.

Mass., Worcester—The Grocers Bread Co. will soon award the contract for the construction of a 2 story, 110 x 130 ft. bakery on Main St. Estimated cost, $100,000. L. S. Beardsley, 116 West 39th St., New York City, Archt.

Vt., Brattleboro—The Windham Co., milk producers, has awarded the contract for the construction of a 2 story, 50 x 80 ft. dairy on "C" St. Estimated cost, $40,000.

Vt., Stowe—The Mt. Mansfield Creamery has awarded the contract for the construction of a 2 story, 25 x 100 ft. grist mill. Cost between $15,000 and $18,000.

MIDDLE ATLANTIC

Md., Baltimore—The Delion Tire & Rubber Co., Trenton, N. J., has bought the plant and equipment of the Dreadnaught Tire & Rubber Co., Orangeville, Baltimore, and will install additional machinery. J. W. Price, Pres. Noted June 10.

Md., Baltimore—The Presto-Light Co., Inc., 30 East 42nd St., New York City, has awarded the contract for the construction of a 1 story, 25 x 50 ft. acetylene plant, here. Estimated cost, $75,000. Noted June 24.

N. J., Newark—The New Jersey Ice Cream Co., 316 Mt. Pleasant Ave., is having plans prepared for the construction of a 3 story, 35 x 35 ft. ice cream plant. Estimated cost, $100,000. Voss & Lawritzer, 65 DeKalb Ave., Brooklyn, N. Y., Archts. and Engrs.

N. J., New Brunswick—The Western Sulphur Co., plans to build a fertilizer plant. Estimated cost, $150,000. J. G. Lipman, c/o State Agricultural College, New Brunswick, Pres.

N. J., Trenton—The Luzerne Rubber Co., Muirheid Ave., has awarded the contract for the construction of the first unit of its rubber plant, 1 story, 60 x 60 ft. Estimated cost, $15,000.

N. J., Woodlynne (Camden P. O.)—The Camden Ice Co., c/o B. H. Lackey, Archt., 509 Federal St., Camden, plans to build an ice plant and coal yards, here.

N. Y., New York (Borough of Brooklyn)—The Cone Co. of Amer., c/o Salvati and Le Tuornick, Archts., 373 Fulton St., will build a 1 story, 80 x 150 ft. factory on Clarendon Rd., for the manufacture of ice cream cones. Estimated cost, $40,000.

N. Y., Buffalo—The Pratt & Lambert, Inc., 79 Tonawanda St., has awarded the contract for the construction of a 4 story, 6 x 50 x 55 x 100 ft. factory for the manufacture of varnish. Estimated cost, $75,000.

N. Y., Long Island City—The Allied Printing Assn. of Manhattan, c/o W. E. Austin, archt. and engr., 46 West 24th St., New York City, is having plans prepared for the construction of a 9 story, 80 x 400 ft. printing plant on Jackson Ave. near Harold St., here.

Pa., Philadelphia—Rinald Bros., 1142 Hancock St., will soon award the contract for the construction of a 2 story, 46 x 55 ft. varnish factory, on Grove and Wharton Sts., Penchert & Wunder, 1415 Locust St., Archts. and Engrs.

Pa., Philadelphia—E. B. Steinmetz & Co., Huntington and Hancock Sts., has awarded the contract for the construction of a 2 story, 48 x 105 ft. yarn factory, on L and Sedgley Sts. Noted July 29.

SOUTHERN

La., Bogalusa—The Essential Products Co., 1919 Columbia St., Philadelphia, plans to build a plant here, for the manufacture of essential oils. Estimated cost, $1,000,000.

La., New Orleans—The New Orleans Cigar Box Co., 439 South Peters St., plans to build a cigar box factory, 10,000 cigar boxes daily capacity.

Tenn., Chattanooga—The DuBois Rubber and Tire Co. is having plans prepared for the construction of a factory for the manufacture of rubber products.

MIDDLE WEST STATES

Ill., Chicago—The Borden Farm Products Co., 136 West Lake St., will soon award the contract for the construction of a 3 story, 115 x 210 ft. milk bottling plant, on Clybourn Ave. and Division St. Estimated cost, $250,000. E. E. Roberts, 105 North Clark St., Archt., Westcott Eng. Co., 111 West Washington St., Engrs.

Ill., East St. Louis—The Monsanto Chemical Works, 1800 South 2nd St., St. Louis, Mo., has awarded the contract for the construction of 7 buildings for chemical plant, to include 2 large buildings, one 50 x 100 ft. and other 200 x 200 ft. Estimated cost, $400,000.

Ill., Macomb—The Morris Bros. Shoe Co. has awarded the contract for the construction of a factory. Estimated cost, $35,000.

Mich., Houghton—The Michigan College of Mines has awarded the contract for the construction of a 2 story chemistry. Estimated cost, $125,000.

O., Circleville—The Franklin Shoe Mfg. Co. is preparing plans for the construction of a 2 story, 87 x 100 ft. shoe factory. Estimated cost $35,000.

O., Cleveland—The Concrete Steel Co., 42 Bway., New York City, will build a 1 story, 200 x 200 ft. steel fabricating shop, here. Estimated cost, $200,000.

O., Cleveland—The National Carbon Co., West 117th St. and Madison Ave., plans to build a 1 story addition to its factory. Estimated cost, $150,000.

O., Lakewood (Cleveland P. O.)—L. S. Brooker, 11717 Detroit Ave., plans to build a 1 story addition to its bakery. Estimated cost, $50,000.

O., Lorain—J. C. Newman Cigar Co., 3803 Woodland Ave. Cleveland, has awarded the contract for the construction of a 2 story, 40 x 94 ft. addition to its factory, here. Estimated cost, $25,000. Noted June 10.

Wis., Merton—The Merton Dairy Products Co. will soon award the contract for the construction of a 3 story, 60 x 145 ft. dairy products factory on Main St. Estimated cost, $40,000. M. Tullgren & Sons, Wisconsin Natl. Bank Bldg., Milwaukee, Archts.

Wis., Milwaukee—The Wisconsin Food Products Co., Berlin Arcade, is having plans prepared for the construction of a 1 story, 60 x 200 ft. garage on Port Washington Rd. Kirchhoff & Rose, Majestic Bldg., Archts.

Wis., New London—The Borden Condensed Milk Co., 136 West Lake St., Chicago, Ill., is having plans prepared for the construction of a 4 story, 60 x 250 ft. milk can factory, here. Estimated cost, $100,000.

Wis., Saukville—G. Sulman & Sons Co., 337 7th St., have awarded the contract for the construction of a 2½ story, 57 x 149 ft. factory on Main St., for the manufacture of leather specialties. Cost between $45,000 and $50,000.

Wis., West Bend—Schmidt and Storck Wagon Co. is having plans prepared for the construction of a 1 story, 100 x 270 ft. wagon factory on Main St. Estimated cost, $70,000.

WEST OF THE MISSISSIPPI

Mo., St. Louis—The Crunden Martin Mfg. Co., 760 South 2nd St., manufacturer of woodware, has awarded the contract for the construction of a factory. Estimated cost, $350,000.

Tex., Corsicana—The Central Texas Grocery Co. has had plans prepared for the construction of a cold storage plant. Estimated cost, $20,000.

Tex., Dublin—The Keystone Refining Co., will soon award the contract for the construction of a petroleum oil refinery. Estimated cost, $100,000.

Tex., Italy—The Watson Gin Co. will soon award the contract for the construction of a cotton gin. Estimated cost, $30,000.

CANADA

Ont., Port Arthur—The Provincial Paper Mills, Ltd., 76 Adelaide St. W., Toronto, has purchased the Port Arthur Pulp and Paper Co., here, and is contemplating the erection of a new book paper mill.

Ont., Toronto—The Canada Bread Co., 160 Avenue Rd., plans to build a 3 story bakery on Danforth Ave. Estimated cost, $250,000.

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Business Opportunities—Employment

SEARCHLIGHT SECTION

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